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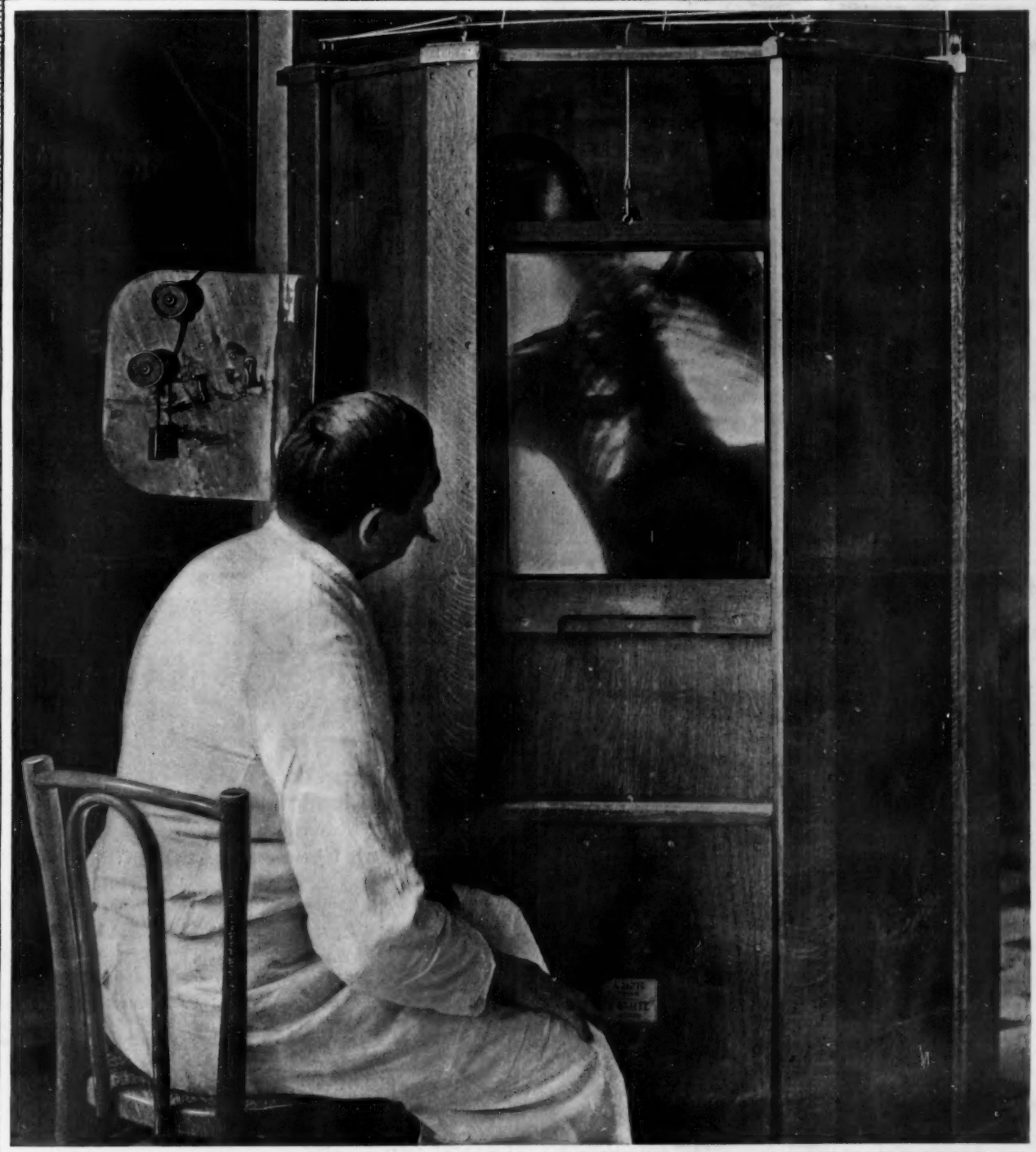

The Latest Improvements in X-ray Apparatus

The Problem of Our Navy—VII. Personnel

The Plumbing of the Human Body

Vol. CX. No. 15
April 11, 1914

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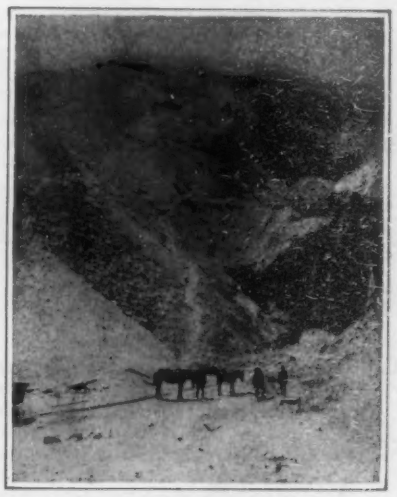
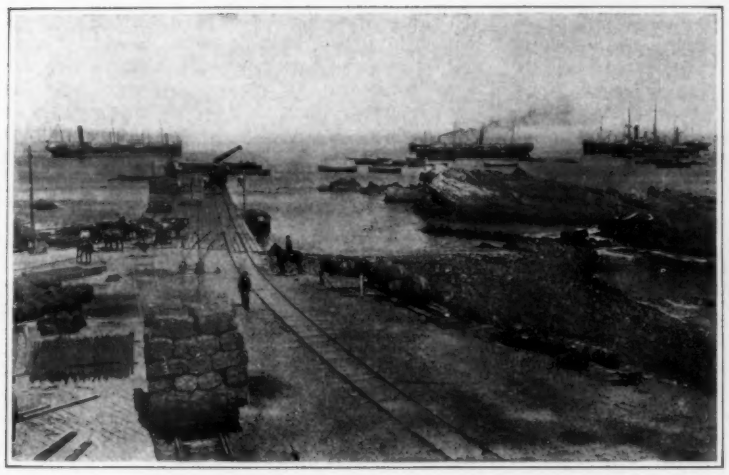
"Cathedral cut" at Chuquicamata.

One of the more extensive excavations.



A native ore concentrator.



The port of Tocopilla, where the 40,000-kilowatt plant is being built.

The deposit honeycombed with burrows of individual miners.

A Mountain of Copper

EIGHTY-SIX miles inland from the Chilean port of Tocopilla, a mountain rises to an elevation of 9,500 feet. This is not a remarkable height for a country that lies under the shadow of the Andes and yet the mountain is a conspicuous landmark for miles around because of its bright copper green color; for here is the great copper deposit of Chuquicamata, one of the largest copper deposits in the world. It covers an area 8,000 feet long by 500 to 1,200 feet in width, and the borings so far made indicate that it must contain at least two hundred million cubic yards of copper ore. What such a quantity means we can gather by comparing it with the excavation for the Panama Canal which will total 230,000,000 cubic yards. Most of the deposit consists of two per cent ore, but the value of the ore increases with the depth. Borings which in place have been carried down from 1,000 feet to 1,285 feet show that the underlying ore contains 3.17 per cent of copper.

Up to 1911 the deposit was owned by individuals and separate owners. Because a large part of it is exposed, and there is no surface soil to be stripped off, hundreds of open cuts have been made by miners who sought only high-grade ore. In fact, the whole surface of the mountain is honeycombed with such burrows. Some of them are 300 feet deep, but the total amount of copper excavated is comparatively insignificant, and nothing was done with the low-grade ore. Now the whole mountain has been taken in hand by an American company, which is prepared to excavate the entire deposit and recover the copper it contains by means of the electrolytic method. Work is well under way on a plant which will handle ten thousand tons or more per day.

Electricity will be furnished from a 40,000-kilowatt steam power house at Tocopilla (the man who is not familiar with South American geography will find this port on the map about twenty-two degrees south of the Equator). The power plant will have four turbo-generators of 10,000 kilowatts each. The fuel used in the plant may be either coal or oil, but it is planned to use oil, shipped from the California oil fields. The transmission line running from the power plant to the electrolytic plant will be eighty-six miles in length and will be of sufficient capacity to deliver 21,000 kilowatts at the mine. This will provide for treating ten thousand tons per day. The current will be transmitted at a voltage of 110,000, and the line will be strung on steel towers, spaced eight to the mile. When the capacity of the treatment plant has been increased to double that amount a second transmission line will be erected. Although there is some water-power available in the vicinity of the mine, it was decided to build the steam power plant on the coast in order to save time. Later on hydro-electric power will also be used.

The ore will be mined with steam shovels from the Panama Canal. The method of extracting the copper will be to crush the ore and place it in large concrete tanks. Here it will be treated with a copper sulphate solution, consisting of eight per cent sulphuric acid and one and one half per cent copper. After soaking here for forty-eight hours the solution will be passed through the electrolytic tanks where the copper will be deposited. The sulphuric acid left in the tank after the copper has been extracted will be used for the treatment of the crushed ore. After the first treatment with sulphuric acid, no more acid will have to be introduced into the operation as enough will be obtained from the electrolytic tank, which will extract the sulphate in the ore. Experiments with this method of recovery show that ninety per cent of the copper in the ore can be extracted. Hence, it is expected that the ten thousand ton plant now being built will produce 120,000,000 pounds of copper per year. The mill is about three miles from the mine; and a plant railroad is being built which will be about twelve miles long. The Chuquicamata mine is reached by a branch line from the Antofagasta and Bolivia Railroad, and is a hundred and fifty miles by rail from Antofagasta.

Over fifteen hundred men are at work on the plant.

To accommodate the workmen at Chuquicamata the company is building a city which will contain among other buildings a soldiers' barracks, two public schools, a court house and telegraph and postal building, a theater, a hospital, a public quarantine, a Protestant church and a Catholic church, a music hall for workmen, and a public library. The city will consist of two sections, one for foreigners and the other for natives. It will probably be the finest industrial town in South America. Work on the plant, the power plant, and the workmen's villages are proceeding rapidly, and it is expected that copper will be produced within a year's time.

Air Pressures in Playing Wind Instruments

IN an interesting article in the *Philosophical Magazine*, Mr. Foord refers to Dr. Stone's table of wind pressures required to play various notes of the scale on various wind instruments. The table indicates that as the notes rise higher in the scale the air pressure necessary to produce them increases with most wind instruments, although not with all. In the clarinet, for example, the pressure decreases from the low notes to the high ones, varying from 15 inches of water to 8 inches. Mr. Foord repeated these experiments on the clarinet and saxophone, playing the whole range of notes first loudly and then softly. For the clarinet it is found that the pressures fall as the notes rise, agreeing with Dr. Stone's table, although the inverse law holds good for the oboe, bassoon, horn, cornet, trumpet, euphonium, and bombardon.

With the saxophone it is found that the pressures corresponding to notes at the beginning and end of the register are equal, the pressure rising to a maximum at the note D about half-way through the scale.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Tolls Question in the House of Representatives

ALTHOUGH on grounds of decency and dignity there was much to deplore in the debate which preceded the passage of the Tolls Repeal Bill in the House, it is perhaps as well that its opponents should have given loose rein to the prejudices and animosities which characterized their speeches. These gentlemen have spoken and the country has listened with close attention, with much enlightenment, and incidentally with no little amazement.

The country has a right to expect of its representatives that whenever a subject of grave international importance, such as this question of tolls, comes up for debate, it shall be considered strictly upon its merits, and that the discussion shall be free from the least taint of mere party politics and all the insincerity, byplay, and subterfuge which the "political game" implies. Above all, a debate of this kind should never be vulgarized by the interjection of personalities.

Say what he will, the most bitter opponent of repeal must admit that this country is on trial before the whole world in the matter of its good faith and the sanctity of its treaty obligations. There is no getting away from this fact; for the President himself, in a joint session of the two Houses, has so stated the situation, telling Congress in simple words of unmistakable meaning, that the honor of the country was at stake.

Surely, anyone with the most elementary sense of ethics, or even of the common proprieties, must have felt that this was an occasion for cautious and dignified debate; and to the credit of many of the opponents of the bill, it can be said that their speeches were delivered in this spirit.

But, although many of the representatives spoke and voted against repeal under a mistaken but sincere misapprehension of the treaty, some of the opposition were manifestly swayed by other motives than a desire to get at the truth. Among these were subsidy seekers pure and simple; those who do not hesitate to stir up racial animosity; and not a few who did not disdain to descend to personal abuse of the President himself.

As regards the last-named, it is sufficient to say that envy has ever been the parent of malice. President Wilson is too firmly established in the confidence and respect of the country to be shaken by the angry chattering of a few disappointed politicians.

There is no doubt that the principal opposition to the bill comes from the coastwise shipping interests and from the politicians. Such opposition as has been developed among the public at large is the result of an active campaign, in which the arguments have been of the most specious character, and have consisted largely in an appeal to racial prejudice. We had hoped that this sort of tactics belonged to an earlier and cruder day. No one seriously believes that the President has taken his firm stand in favor of fulfilling treaty obligations on any other ground than that of national honor. To suggest that he is acting under pressure from any foreign power, and that he has made a "deal," in which our own treaty rights have been used to buy off foreign interference in Mexico or elsewhere, is to do violence to the very qualities which have won for our President so strong a hold upon the confidence and high regard of the country.

The Tolls Bill has gone to the Senate strengthened by the prestige of its passage through the House. The questions involved are: First, can we as a nation which boasts of its square dealing afford to repudiate a clearly-stated treaty obligation? Second, is there any good reason why a large portion of the revenues of the Canal, built, as it has been, by all the people of the country, should be diverted to that exceedingly small minority of the people who own and run our coastwise shipping? We believe that the patriotism and clear thinking which carried the bill through the House will prevail in the Senate also.

The North River Bridge Problem

PROMINENT among the great engineering questions which perennially thrust their way into public notice through the medium of the public press, is that of the construction of a bridge across the North River. So many have been the ways and means which have been proposed for putting through this work, that the public will welcome in this issue the clear and comprehensive letter from Gustav Lindenthal, who a quarter of a century ago made the first definite proposal and working plans for a bridge across the North River. As Bridge Commissioner under the Mayor Low administration, the writer of this letter had every opportunity to become acquainted with the ins and outs of the construction and operation of great public utilities, and notably of the great bridges which have been built across the East River.

Every one admits that the time is ripe for the provision of larger and more rapid facilities for intercommunication between New York and Jersey City; and the two questions upon which there may be division of opinion are first, as to whether this communication should be established by a single monumental bridge or by multitudinous tunnels; and second, as to whether the results can be best achieved by public money, that is by the cities and States concerned, or by private capital.

Judged on the score of the capacity afforded for a certain cost, there can be no question that a bridge is to be preferred to tunnels. A bridge such as that illustrated in this issue, costing $76,000,000, would have the same capacity as nine pairs of tunnels, costing $180,000,000. Next to the railroad traffic, the automobile traffic will be the largest; and it is certain that the multitudinous automobiles and motor trucks would travel with more safety and convenience by way of a bridge than through tunnels that must be three miles in length if the grades are to be kept down to a reasonable limit. There would be serious fire risk in sending a heavy automobile traffic through a three-mile tunnel, and the problem of getting rid of the noisome gases in tunnels of such a length is a very serious one indeed. Indeed, the difficulty of ventilating tunnels of that length that were carrying a heavy automobile and motor truck traffic would seem to be almost insuperable.

To insure its success, any plan for connecting Manhattan with New Jersey should include the co-operation of the railroads, at least so far as the handling and distribution of freight is concerned. The present method of distribution by car float and trucking, not only encumbers the river and the Manhattan piers and marginal streets, but it is antiquated and altogether behind the best modern practice. The city has under advisement plans for a great marginal elevated freight railroad and storage warehouses, which would be rendered doubly efficient if the freight trains were brought in to Manhattan over a bridge to a connection with the marginal elevated tracks.

As to the question whether the bridge should be built with public or private funds, we think there can be no doubt that the latter plan, as outlined in Mr. Lindenthal's letter, would be the more satisfactory. He tells us that every one of the four existing East River bridges cost from 80 to 120 per cent more than the original estimate at the time the bridges were authorized, and this is only in keeping with the sad experience which New York city and State have had with regard to other important engineering works that have been built with public funds. The Catskill Water Supply, originally estimated to cost $160,000,000, will probably total nearer $200,000,000 by the time it is completed; and the Erie Canal, estimated to cost $100,000,000, promises to cost nearly $150,000,000.

If the present grossly unfair treatment of the railroads shall come to an end, that is to say, if they are once more permitted to operate according to true economic laws and, therefore, should feel justified in facing large expenditures in improvement of their systems, they will probably find the proposed railway connection with Manhattan an attractive proposition; and if the two States, New York and New Jersey, should co-operate, we understand that there would be no difficulty whatever in securing from private sources the $76,000,000 of capital needed to build the bridge.

Dr. Zimmerman's Aerodynamic Studies

A NOVEL and most important line of work in advancing aeroplane design has been inaugurated by the section for scientific aviation of the *Berliner Verein für Luftschiffahrt*. The task was to determine and correctly measure vital constants of a Grade monoplane, such as weight, center of gravity, moments of inertia, and most important, the several axes of inertia oscillations. Dr. Zimmerman, who worked out the theory of these investigations, was in charge of the work, which with the rather primitive accommodations at his command took no less than twelve days. It was found that to take these important measurements of any finished machine speedily and economically, an entirely new accessory to the flying machine is needed; a large dome-shaped building, with facilities for suspending the aeroplane in any desired fashion, so that it is free to oscillate only about the axis to be investigated, with windlasses, and also swinging galleries, by which any portion of the machine can be approached without disturbing the rest.

These constants are at present only partly known. A correct understanding of the several axes of inertia oscillations (the various axes, fixed by the arrangement of weight, about which a machine begins to rock if its equilibrium is disturbed in different ways) will simplify the all important stability problem, which has so far been dealt with only by cut and try methods, and which in the aeroplane is a matter more of dynamics than of statics. It will give us safer and more useful machines.

Such an advance is more beneficial than a new record made by a flying virtuoso, who cannot impart his personal, almost subconscious art to others.

The Composition of Air and Rain-water in the Antarctic

ONE of the most interesting undertakings of Dr. Charcot's expedition to the Antarctic in 1909 and 1910 was the collection by Ensign R. E. Godfroy of the French navy, in accordance with the instructions of A. Müntz, of a great number of samples of air and meteoric water (rain and melted snow), which have since been analyzed in Paris. An elaborate report on the analyses has been published by Messrs. Müntz and Lainé in the *Annales de l'Institut National Agronomique*. In order to determine the amount of nitric acid in the atmospheric precipitations of the Antarctic, samples of meteoric water, as collected, were dosed with a small quantity of potash, concentrated by evaporation over a flame, mixed with alcohol, and hermetically sealed. This substance is supposed to be formed by the electrical discharges of thunderstorms; a belief supported by the fact of its relative abundance in tropical regions, and its almost complete absence at great altitudes, where thunderstorms rarely occur. The samples brought back by the Charcot expedition show that it is approximately as abundant in the Antarctic as in Europe, despite the rarity of thunderstorms in high southern latitudes. It may, however, be produced elsewhere and carried thither by the winds. Other samples, collected by a different method for testing the percentage of ammonia, show that the latter substance occurs in about the same quantities in the Antarctic as in middle latitudes. Samples of air were collected for the purpose of testing the amount of carbon dioxide. In the atmosphere of the world as a whole this gas has heretofore been stated to form a little less than 3 parts in 10,000 by volume. Determinations by Müntz and Aubin at a number of places in the northern hemisphere give a mean of 2.82, while at Cape Horn they found only 2.56. The mean of all the samples collected by the Charcot expedition shows the strikingly low value of 2.05.

The Monthly Weather Review

PERSONS interested in meteorology will be glad to see in the January, 1914, number of the *Monthly Weather Review* a return to something like the scope and character which made this journal one of the most useful periodical publications of the Government prior to July, 1909. The status of meteorology in the United States is peculiar in the fact that all but a very small percentage of its devotees are connected with the official Weather Bureau, either as paid employees or as volunteer observers, and are therefore entitled to be supplied with professional literature at Government expense. For this reason it seems impossible to maintain an independent meteorological journal in this country. The admirable *American Meteorological Journal*, published from 1884 to 1896, was not only a labor of love, but a source of heavy expense to its editors. After it ceased publication the official *Monthly Weather Review* gradually broadened in scope and became known throughout the world as the mouthpiece of American meteorology. In 1907 the Weather Bureau established a more strictly technical and decidedly less readable publication known as the *Bulletin of the Mount Weather Observatory*, and in 1909 the *Monthly Weather Review* became mainly a bulky collection of climatic statistics. Its literary features, though not entirely eliminated, were mostly devoted to questions of local climatology. In short, from July, 1909, to the beginning of the present year, the United States possessed no journal of general meteorology, such as has now, very fortunately, been re-established.

Engineering

The Electrification of Chicago Railway Terminals.—An elaborate report on the question of smoke abatement and the electrification of the railway terminals will be presented in a few months' time by a committee of the Chicago Association of Commerce. The work of the committee was commenced in 1911, and in the interim it has made a most extensive study of 4,500 miles of railway track, including nearly 100 railway yards.

Excellent Torpedo Record.—The United States cruiser "California" recently established a new record for torpedo firing during battle practice off the coast of California. The firing took place at a range of 3,000 yards when the cruiser was steaming at 10 knots. The first five shots were bull's eyes, the sixth was a miss, and the seventh torpedo stuck in the tube, and according to the rules was counted as a shot.

Another Large Motor Ship.—There was launched by Messrs. Harland & Wolff on March 12th a large motor ship, the "Falstria," for the East Asiatic Company, who are the owners of the "Selandia," and sister ship. The "Falstria" is 381 feet long, 50 feet broad and has a gross tonnage of 4,500. The main engines will consist of a pair of Burmeister & Wain four-stroke, six-cylinder Diesel engines, with two auxiliary Diesel engines for the air compressors and dynamos.

An Oil Burner Record.—The freighter "Santa Cruz" arrived last month at San Francisco with a new record for the passage by way of the Straits of Magellan. From the time the vessel left Sandy Hook till she slowed down off Los Angeles harbor, the engines were run full speed without a stop, and the distance of about 13,000 miles was made in 47 days and 4 hours. The "Santa Cruz" is an oil burner, and therefore did not need to put in at any port for fuel.

The Soo and the Suez Canals Compared.—William C. Redfield, Secretary of Commerce, in a recent address drew attention to the fact that the number of ships passing through the river and canal connecting Lake Huron and Lake Superior amounted last year to nearly three times the number that passed through the Suez Canal. To be exact, 14,916 vessels of 30,974,123 tons passed through the Great Lakes Canal, while 5,300 vessels of 20,275,133 tons passed through the Suez Canal.

The Situation at Cucuracha Slide.—The last number of the *Canal Record* states that approximately 1,000,000 cubic yards of material has been dredged from the toe of Cucuracha slide. The dredges began operation there on October 26th, 1913. On March 4th the channel at the base of the slide had a minimum width of 190 feet and a minimum draft of 20 feet at the level of Gatun Lake. The removal of this material has caused a marked lowering of the masses of material in the upper reaches of the slide.

A Concrete Hardening Material.—Mention is made by the *Engineer* of a concrete hardening material containing 95 per cent iron dust or iron flour, which is mixed with cement for finishing the surface of concrete floors. From 15 to 25 pounds of the material is mixed with 100 pounds of the cement while dry, and one part of this mixture to two parts of sand is used for the top coat, which varies from one half inch to one inch in thickness. It is said to make a hard and durable floor. It is serviceable also in making new concrete adhere to old concrete in repair work.

Canal Machinery Should Be Sold.—The suggestion has frequently been made that the canal excavating machinery might be used to good effect in levee work on the lower Mississippi, or that some of the machinery might be used to build the Alaska railroad, or to do general river and harbor work in the United States. Col. Goethals recently told the Senate Commerce Committee that it would be more economical to purchase new machinery outright for the Mississippi improvements than to remove and repair the canal machinery. The only part that might be utilized would be some of the dredges, and these, he thought, would be of doubtful utility. He recommended that cars, dredges, engines and all other machinery be sold to South American interests which wish to use them in railroad building.

United States Collier "Jupiter" Makes Over 15 Knots.—The Navy Department is much gratified with the performance of the large collier "Jupiter," in which is being tried out a system of electrical speed reduction. The motive power consists of a turbine-drive, direct-connected to a generator, current from which drives the propeller shaft motors. The contract calls for the maintenance of a speed of 14 knots for 48 hours continuous steaming. On the recent official trial the collier maintained 15.1 knots for 48 hours, an excellent performance, which compares favorably with that of the sister ships "Neptune" and "Cyclops." The former, fitted with Westinghouse reduction gear, has maintained 14.96 knots for 48 hours, and the "Cyclops," fitted with reciprocating engines, has maintained 14.61 knots for the same length of time.

Science

The Fourth International Botanical Congress will be held in London, May 22nd–29th, 1915.

Paint From Beans.—From Manchuria comes the invention of a new paint that is both waterproof and fireproof in addition to being cheap and durable. "Solite" is the name of this new product, and three months after its introduction it found a ready market in Shanghai, Harbin and Tientsin. It is reported that the Japanese navy is testing it with a view to adoption. "Solite" is made from bean oil which is produced in tremendous quantities in Manchuria.

An 1,800 Years Old Egg.—An egg which cannot be said to be fresh is one which dates from 1,800 years back. It was found during recent excavations made at Nikopolis, in the tomb of an 11 months old child, Sextius Rufus. Already more than 80 tombs have been explored by the archæological service in this ancient city, which was built to commemorate the battle of Actium. Among the finds are a quantity of gold jewels, also pottery and lamps ornamented with elegant figures in relief.

The Kritzinger Comet.—A cablegram received at the Harvard Observatory from Kiel announces the discovery of a comet by Dr. Kritzinger of Bothkamp, in the following position:

March 29.6171 G.M.T.
R.A. 16h. 11m. 39.2s.
Dec. —9° 30′ 45″

The comet had a daily motion of +3m. 08s. in R.A., and +32′ in Dec., and was visible in a small telescope.

Further Exploration of the Abor Country.—The northeast frontier of India has become the theater of active and much-needed exploration by British officials, beginning with the operations of the punitive expedition sent against the Abors after the murder of Messrs. Williamson and Gregorson in 1911. During the past winter, a small party was engaged in exploring and surveying the country of the Akas, the most westerly of the Abor Mishmi group of tribes. This region had not been entered by a British party since 1884.

Shorthand Taught by Moving-picture Slides.—The value of illustrated moving-picture slides for teaching shorthand is being successfully demonstrated by a school of Newark. The principal, A. J. Harding, who originated and developed the scheme, has been working on it for the past year and recently began its use in the shorthand department. The moving-picture idea is not only pleasing and agreeable, but is an incentive to the student to accomplish more, for the reason that he is appealed to from a more interesting point of view.

Tomato Seeds for Fodder.—The Chamber of French Commerce at Milan announces successful attempts to produce a valuable cattle-fodder from the tomato seeds which are a by-product of the canneries. The seeds are desiccated in drying-furnaces and then sifted to separate them from the woody fiber of the debris. They are then crushed by heated mill-stones and the oil which they contain in considerable quantities is separated by a hydraulic press. The residue is pressed into loaves each about two kilogrammes in weight. According to tests at the Agricultural Station at Portici, they contain an abundance of proteids and carbohydrates.

Explorations in Northeastern Siberia, on an extensive scale, have been undertaken by Iden Zeller, especially for the purpose of making ethnological collections for the museums of Hamburg and Leipsic. Starting from Yakutsk with a column of natives, the explorer expects to sledge first to the Kolyma River, where he will spend the latter part of this year. After an excursion all the way to Cape Deshnev, he will travel west to the Yana River, and sledge over the ice to the New Siberian Islands, where he has been commissioned by the Russian government to erect a bronze tablet in memory of the late Baron Toll. Later he will explore along the lower Lena and then westward by way of the Taimyr peninsula to the Yenisei and the Ob. He hopes to complete this remarkable journey late in the summer of 1916.

The Abnormal Propagation of Sound Waves in the Atmosphere is discussed in a recent paper published in Tokyo by S. Fujiwhara (who in other memoirs has spelled his name "Fujihara" and "Fujiwara"). The existence of regions of audibility lying farther from a source of sound than regions in which the sound was inaudible ("zones of silence") has been reported in connection with certain great explosions by G. von dem Borne and A. de Quervain, and made especially prominent by Alfred Wegener, who sees in this phenomenon the result of total reflection of sound from an upper atmospheric stratum of great tenuity. Mr. Fujiwhara has collected numerous reports of the audibility of great explosive volcanic eruptions in Japan. He finds that the existence of a silent region is a usual phenomenon, and that the region of audibility always lies in a special direction from the source of the sound; viz., the same direction as the axis of the region in which sand and ashes fall from the volcano. The principal factor in the anomalous propagation of the sound is the wind, and the phenomenon is found to be closely related to the prevailing type of weather.

Aeronautics

The New Noiseless Zeppelins.—The new army Zeppelin V. cruised over Berlin recently with hardly any noise whatever. In the past Zeppelins have been conspicuous by reason of their noise. Their approach was heralded long before they appeared, by buzzing motors. The latest Zeppelin, the ZS, flew over Santis Mountain in the Canton of Appenzell on April 1st, and in so doing created a new height record for dirigibles of 10,000 feet.

Entries for the Gordon-Bennett Aviation Cup.—According to *Flight* the following entries have been made to the Royal Aero Club: Messrs. A. V. Roe & Co., Ltd., Manchester; Sopwith Aviation Company, Ltd., Kingston-on-Thames; British and Colonial Aeroplane Company, Ltd., Bristol; Cedric Lee Company, Shoreham (two machines); Messrs. Vickers, Ltd., Erith and London. The race will be held in France in September or October next, and the Royal Aero Club will select from the foregoing entries three competitors to represent the British Empire.

An Aerodynamic Laboratory for Massachusetts Institute of Technology.—The first structure that the Massachusetts Institute of Technology has caused to be erected for its own uses on its site in Cambridge is the new aerodynamic laboratory. The building is finished and the apparatus is in process of installation. This, together with the fact that Technology has already instituted courses in the study of this science, makes it the first college in the land to be fitted to prepare students for what must in the future be an exceedingly important line of development. The portion of the equipment that is first to be installed, in fact, is nearly ready for use, is the four-foot wind tunnel with its accompanying blower. This is of the pattern now in use at the National Physical Station at Teddington, England.

A Giant Hydro-aeroplane.—The Jeanson-Collieux hydro-aeroplane is one of the largest machines ever built, rivaling indeed even the machine of Sikorsky. It is stated in the French press that the machine flew several miles recently above the Seine River at Priel. The machine is carried by a single boat having a single hydroplane step. The boat is 28.5 feet long by 8.5 feet beam. The aeroplane portion consists of two sets of biplane surfaces arranged in tandem. The span is 27 meters (88½ feet) and the total lifting surface 145 square meters (1,560¾ square feet). Within the boat body are two 200 horse-power motors connected by sprocket and chain with a single air propeller 5 meters in diameter. The total weight of the machine with its pilot, assistant pilot, two mechanicians and fuel and oil for a 15-hour flight (1,600 kilometers—994 miles) is 4,700 kilogrammes (10,360 pounds).

The Race to Bermuda.—An aeroplane race from New York to Bermuda, over a flying course of 700 miles, is being organized for the coming summer. The machines are to leave here in the last week of June or the first week in July. Prize money to the amount of $25,000 will be awarded upon their arrival in Hamilton Harbor, Bermuda. If the race actually takes place it will be extremely instructive because it will shed much light on the possibility of crossing the Atlantic in machines of the present day, for the oversea flying course will be practically one third of the distance which machines entering the transatlantic race would be expected to cover. For a long stretch the aviators will have to fly without any land in sight, relying only upon the compass. The aeroplanes entering for the race will be required to carry wireless outfits capable of transmitting signals to a distance of 75 miles.

France as an Aeroplane Power.—A serious controversy has arisen in France, which is the direct outcome of the great national aeroplane subscription inaugurated two years ago, and as a result of which 208 aeroplanes were presented to the French army. Of these, all but 33 were in active use at the end of last October. These aeroplanes were an addition to the direct orders placed by the army. It is alleged that the aeroplanes bought through the national subscription were not new, and that the orders for new machines fell short by 200 of the number voted. The National Committee, of course, repudiates the charges indignantly, but the French newspapers seem to think it only too probable that certain manufacturers did, in fact, seize the opportunity to dispose of machines not of the most recent and improved type. The investigation started by the National Committee at least served the purpose of calling attention to France's aeroplane strength. In the first year 320 aeroplanes were delivered at the depot at Chalais-Meudon, while the definite orders placed for 1913 amount to a total of 431, of which 286 had been delivered at the end of October last and the balance by now. As a result, 751 aeroplanes have been acquired by the aeronautical establishment of the French army during the past two years and close upon 1,000 machines since the beginning of 1911. Blériot alone has built 181 military machines and Henry Farman 105. No wonder that France has a real aeroplane industry!

The Plumbing of the Human Body

The Surgeon as a Sanitary Engineer

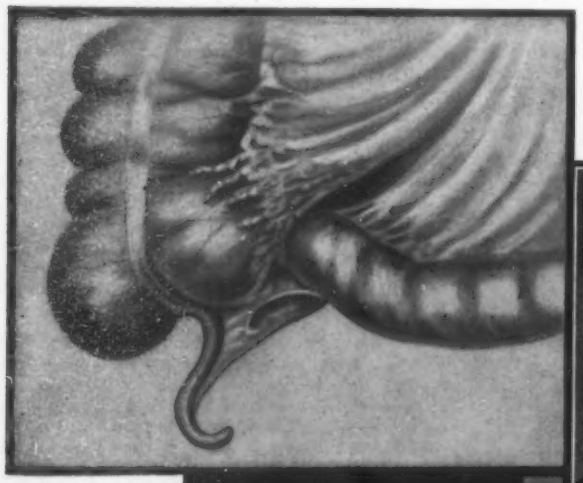
IN the history of every science we can point to certain landmarks, milestones as it were in the road of progress, which stand out prominently from among the general level of gradual advances. Such epochs mark the ushering in of a new era, the opening out of a new horizon.

Has such a point been reached in contemporary medicine? As much has been hinted by some members of the medical profession, and only the future can show to what extent their anticipations will prove warranted by subsequent developments.

If we look back to the early days of the history of medicine we find a very crude hypothesis, the humoral theory, forming the basis of medical teaching and practice. According to this, the cause of disease lies in the testine is held in place in the human body.

It must be remembered that the upright posture of man is presumably a somewhat late acquisition in the progress of his evolution. There are indications that various structures of the body, and in particular the abdominal viscera, have not yet fully become adapted to the comparatively new conditions of erect posture. How far unusual mechanical stresses may go in modifying anatomical structures will be seen from one of the accompanying illustrations, which shows the spinal column of a brewer's drayman, twisted all out of shape to meet the "new conditions" of the stresses produced in the habitual carrying of a cask on the right shoulder. Another engraving shows the elbow joint of a coal trimmer. It has become much strengthened by butdue stress, caused by injudicious attire or mode of living, these bands gradually outgrow their proper limits, and instead of being merely supporting members, and thus useful, they become distorting members, causing the intestine to become kinked, and rendering the passage of material through it more and more difficult. Thus, according to Lane, arises the condition technically known as intestinal stasis. The plumbing of the human body is out of order and stagnant. Poisons, toxic products, which ought to be discharged, are retained in the body and produce effects manifesting themselves in a great variety of ways.

As regards the harmful influence thus exerted, Sir Arbuthnot Lane, in an address delivered at the North East London Post-Graduate College, says:



By courtesy of *Woman's Medical Journal*

FIG. 1.—View showing caecum and appendix in normal condition. Compare the condition shown in view opposite.

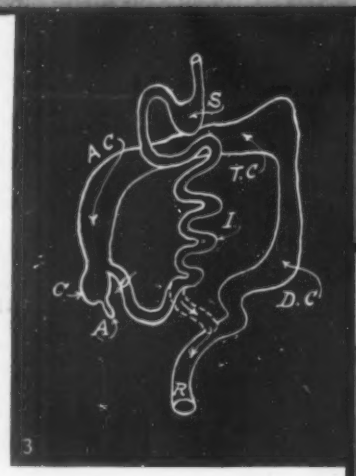


FIG. 3.—Diagram of Lane's method of short-circuiting out the entire colon from the alimentary tract. *S*, stomach; *I*, small intestine; *C*, caecum; *A*, appendix; *AC*, ascending colon; *TC*, transverse colon; *DC*, descending colon; *R*, rectum. The broken lines indicate artificial connection made by operation.

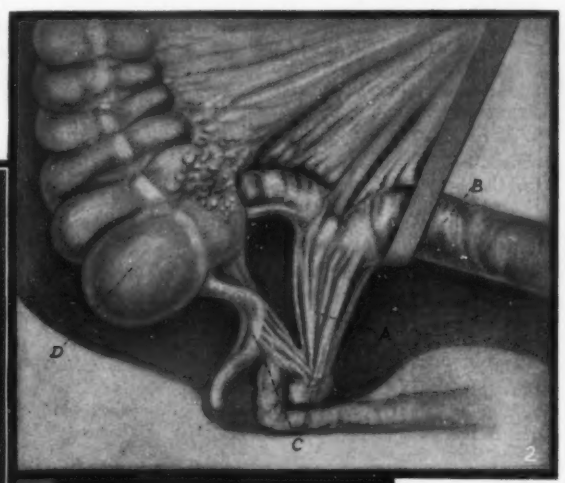
Sir W. Arbuthnot Lane, Bart.

Originator of the "Lane Plate" for joining together the broken ends of fractured bones.

By courtesy of Bibliographies of *Guy's Hospital Men*

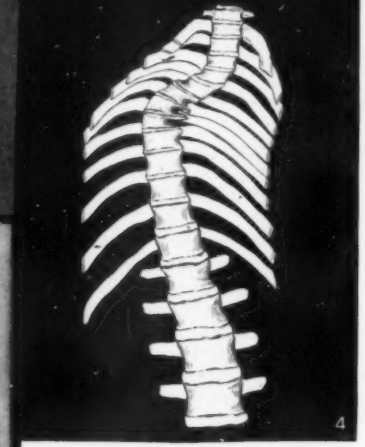
By courtesy of *Proceedings of Royal Society of Medicine*

FIG. 5.—Elbow joint of a coal trimmer.



By courtesy of *Woman's Medical Journal*

FIG. 2.—(*A*) Lane's band, producing (*B*) ilial kink. (*C*) appendix caught in band. (*D*) dilated caecum. Compare normal organs in view opposite.



By courtesy of *Proceedings of Royal Society of Medicine*

FIG. 4.—The spinal column of a brewer's drayman, showing deformity produced by habitual carrying of load upon one shoulder. An illustration of nature's efforts to adapt the body to new conditions.

human economy, in which the balance between the four "humors" has in some way become disturbed. Remnants of this speculation are still found in our everyday language, in such expressions as "melancholic" or "choleric" temperament—since the humors (Greek chole, bile) were supposed to determine a man's temperament.

Since the days of Pasteur we have become accustomed to seek an external cause for many diseases, which owe their origin to bacterial infection.

But this is only a partial solution of the problems presented by disease, for it is well known that we all daily take into our bodies countless microbes without suffering any observable ill-effects.

In fact, microbes have little or no terror for the man "in perfect condition"—before they can gain a footing the ground must have been in some way prepared for them, there must be "predisposing" circumstances. This, of course, has long been well understood, but it would seem that one very important predisposing factor has not been fully appreciated or traced to its ultimate source. True, it has always been realized that disturbances in our alimentary tract were responsible for many more or less grave consequences and predispositions for disease. True, also, that Prof. Metchnikoff in particular taught very emphatically the deep significance of fermentative changes going on in the intestine, and their probable relation to the premature "ageing" of the individual.

But if the views now put forward are substantiated by further evidence, it would seem that one of the dominating factors producing many of the disorders of our alimentary tract, with the far-reaching consequences in their trail, had not hitherto been properly appreciated. This factor is in the first instance purely mechanical, and relates to the manner in which the intresses of bone which increase the area of the articular surfaces and render the fit more accurate.

These advantages have been gained at the expense of an abnormally limited range of flexure, the photograph showing the arm in its limiting position.

These are examples of some of the changes produced in the human anatomy by nature's efforts to meet new and unusual conditions. As is clear from the illustrations given, the result is far from being wholly happy—an advantage is gained at the expense of some more or less undesirable deformity. And what has this to do with disorders of the alimentary tract? The connection is obvious enough once it has been made clear, as it has been by the labors of Sir Arbuthnot Lane. Nature, in its effort to afford adequate support to an intestine deprived of its original resting base, the abdominal wall, produces here and there special supporting bands—crystallizations as it were of lines of force, lines of tension—to suspend certain loops of the canal. If the matter stopped there, all might be well. But under un-

"Perhaps the best scientific confirmatory evidence I can put forward of the harmful effect of defective drainage, both of the body as a whole and of the several tissues which constitute it, has been afforded recently by the remarkable experiments of Carrel in the growth of living tissue, in which he has shown that tissues are immortal, and grow to the greatest advantage if the drainage of their toxic products is carried out effectually."

The field thus opened up by Lane has been entered by a number of prominent members of his profession, whose findings seem to substantiate his views. Says Dr. William Seaman Bainbridge in the *Boston Medical and Surgical Journal:*

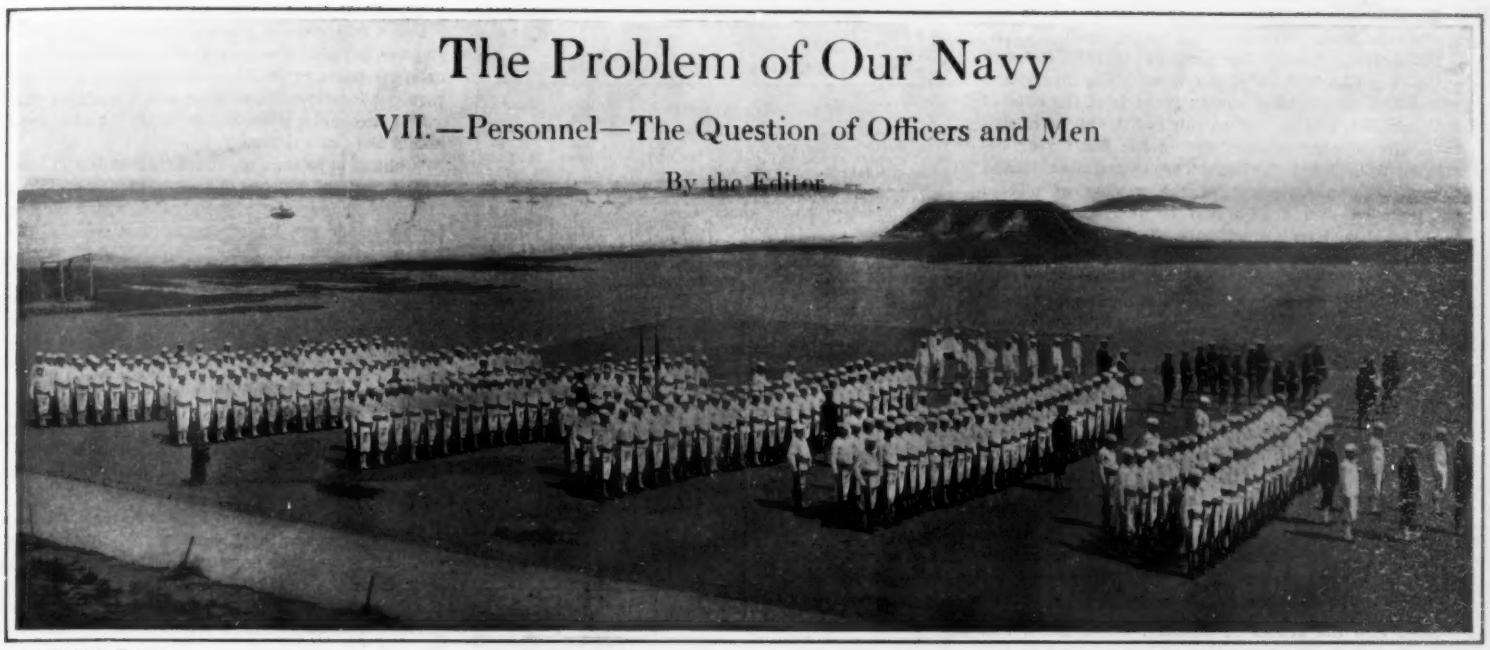
"It seems to me that he (Sir Arbuthnot Lane) makes out a very good case for his mechanical or evolutionary theory of the origin of all the adventitious structures which, in his opinion, play so important a part in the production of chronic intestinal stasis. It may be said, however, that much work needs yet to be done before any theory can be firmly established. We are only beginning to explore the field which he has opened to us. The establishment of the existence of these various structures takes us a long way. We have yet to determine more about their origin, and to follow the leads which he has given us with reference to the far-reaching effects of the conditions brought about by the development of these structures. The field, it seems to me, is one of the most alluring and promising which modern medicine and surgery present. It is certainly rich in promise for the many who, otherwise, would be doomed to more or less complete chronic invalidism."

In the diagnosis of stasis, X-rays are most valuable in disclosing kinks in the intestine. The treatment may consist in medication, in "ironing out" kinks by judicious exercise and wearing of suitable belts, or, in more pronounced cases, surgical interference may become desirable. This may consist merely in the cutting of some of the adherent bands, or in extreme cases, the greater part of the large intestine (colon) may be sidetracked, i. e., short-circuited or removed. The colon appears often to be a rather unnecessary and in some cases even a harmful organ, which can well be spared when the need arises.

The Problem of Our Navy

VII.—Personnel—The Question of Officers and Men

By the Editor



IF we were asked to select the one element of supreme importance among the many which go to make up naval efficiency, we should unhesitatingly name the personnel—the officers and men. In saying this, we are mindful of the fact that in previous articles of this series we have shown that the instruments of war will have a much greater influence in determining the issue of naval battles of the future than they had in the days of sail power and the smoothbore. The highly technical and scientific character of war material—ships, guns, instruments of precision, etc.—undoubtedly has exercised a general leveling effect, and has tended to give *matériel* a greater relative importance as compared with personnel than obtained in an earlier age. While that is undoubtedly true, and no amount of dash and courage can counterbalance a great superiority of the enemy in *matériel*, the fact remains that, when the contending fleets are approximately equal in strength, the issue of the fight will be determined by the judgment and skill of the officers and the discipline and courage of the enlisted men. For proof of this we do not have to go further back than the Russo-Japanese war and the often-quoted battle of Tsushima. In that great fight the fleets were fairly well matched; indeed, if there was any advantage, it lay with the Russian fleet, the leading ships of which represented the most advanced practice in naval construction. Moreover, there was a decided superiority in the number of armor-piercing guns carried by the Russians.

But on the Japanese side the ships were manned by highly trained and experienced officers and thoroughly disciplined crews, whereas the personnel in the Russian fleet consisted of officers of little experience in naval maneuvers and the enlisted force was largely made up of absolutely untrained crews, many of whom were making their first voyage in a warship. The result was inevitable, and the really excellent first fighting line of the Russians, poorly maneuvered and unable to either seriously hurt the enemy or to present that defense which a well-directed fire always offers, was completely overwhelmed in one of the briefest and most sweeping victories recorded in all the history of naval warfare.

The preceding articles of the present series on our Navy have been so largely critical that it is with relief that we turn to a phase of the question in which we can speak of the Navy in terms of unqualified commendation. It is our belief that the personnel of the United States Navy, as regards both the officers and the men, is the most efficient to be found in any of the navies of the world. As a people, from the very beginning of our history, we have shown a peculiar aptitude for the sea; and this is true both of the Navy and of the merchant marine. Our clipper ships of the middle period of the nineteenth century were the fastest and most ably handled of any that have ever sailed the seven seas; and in the war of 1812 it was proved over and over again, in many a hard-fought duel, that, under equal conditions, ship for ship and crew for crew, we were more than a match for the enemy. *Whenever the Congress has given our Navy a chance and treated it with reasonable liberality in the provision of ships, officers and men, the Navy has responded most nobly to the call, and in all the history of the republic there are no pages which are read with more justifiable pride than those which tell of the exploits of our individual ships upon the high seas.*

One does not need to have a very intimate knowledge of battleships, torpedo boats, submarines, and of the complicated duties involved in the command of a warship, and in the maneuvering of squadrons and fleets upon the high seas, to realize that the successful discharge of the duties of a naval officer imposes a strain upon his physical and mental powers, so great that it can be successfully endured only by men of exceptional physique, training and ability. From the time of his graduation from Annapolis, the naval officer, whether as ensign, lieutenant, commander, captain or rear admiral, has imposed upon him duties which for their successful fulfillment will make heavy demands upon his physical and mental equipment. His rise in the service will depend upon his ability and zeal, and upon the nature of the service regulations which are made for passing him up from grade to grade as he rises in rank. His zeal and abilities are personal to himself; but the service regulations, so far as they govern his rise, are arbitrary. As matters now stand, the regulations for the promotion of officers are extremely faulty; for they tend to keep him so long in the lower grades that by the time he is promoted to the command of squadrons and fleets, he is long past his prime, and therefore is not able to do justice to himself or to the service under the very exacting duties and graver responsibilities that have come upon him.

The admiral who leads into battle a fighting line of twenty dreadnoughts is responsible for 20,000 men and $200,000,000 worth of the nation's property, which, through his momentary indecision or error, may be destroyed in an hour's time and would take many long years to replace. A rear-admiral is responsible for $50,000,000 worth of property, and each captain for $10,000,000. Weighed in the monetary scale, the responsibility of these officers is enormous. The financial loss in the event of defeat, however, is insignificant compared with the fact that the annihilation of that battleship line would mean for the United States the complete collapse of our foreign policies, the loss of our insular possessions and a blow to our lately-acquired prestige as a leading world power, from which it would take us many a long decade to recover. Evidently the men who hold command rank, all through the grades from lieutenant-commander to admiral, should represent the very cream and flower of the service. They should leave each grade thoroughly equipped with the knowledge and facility which can be gained only by serving the term of years incidental to the various grades, as they pass through them. Furthermore, the naval officer should be possessed of that almost instinctive quickness of perception and action, which can result only from years of experience in that particular grade in which he is serving when the critical hour of battle arrives.

Are the conditions which govern promotion among the officers such as will secure the above results?

They are not; for unfortunately the present laws as determined by Congress are not such as to bring the best of our officers to the upper grades sufficiently early in their lives to give them that combination of mental and physical vigor and ripe experience which is necessary to make them fully efficient.

The total number of line officers and the number in each grade are determined each year by Congress; and there is no prerogative of Congress which it guards so jealously and with regard to which it is so sensitive as that of fixing the number of our land and naval forces. Thus, for the present year Congress has determined that there shall be 18 rear-admirals, 70 captains, 112 commanders, 170 lieutenant-commanders, 300 lieutenants, and 350 junior lieutenants and ensigns. Entrance to the Navy is by way of the naval academy at Annapolis, and entrance to Annapolis is by appointment under a law which grants to each Congressman and each Senator the privilege of appointing two young men to the Academy. Also forty are appointed each year by the President.

Now, under this arrangement the Naval Academy is sending into the service from 150 to 160 graduates per year. That is the supply; and every one of these young men, as he leaves the Academy, should have a reasonable expectation that he will rise steadily by merit and promotion from grade to grade, until he reaches command and flag rank, that is to say, the rank respectively of lieutenant-commander and admiral.

It is evident that, since Congress limits, each year, the number of officers in each grade, promotion from the lower ranks can proceed only as fast as vacancies occur. These vacancies are due to retirement on account of age (62 years) or to death, disablement, resignation, dismissal, and other causes. The total vacancies from all causes amount to not over 50 per year. Hence, we have a situation in which line officers are entering the service at the bottom at the rate of 150 per year, and leaving it at the top at the rate of 50 per year, with the result that there is an ever-increasing congestion in the lower grades.

Now the mischief of all this is that, unless the system be radically changed, our ensigns will be about forty years old before they are promoted to be lieutenants, and they will be about fifty years old before they reach the rank of lieutenant-commander, fifty-six years old when they become commanders, and well on the way to the Biblical "three-score years and ten" before they can captain a battleship. From this situation results the serious evil that, when the officers reach the ranks of captain and rear-admiral and are entitled to the command of battleships and squadrons, they have long passed that age in which they would have been most fit, both physically and mentally, to perform the difficult duties pertaining to these commands.

This congestion can be met: First, by applying the principle of the survival of the fittest, and selecting every year the best of the officers in each grade for promotion to fill the vacancies in the grades above; second, by removing those officers that are not selected to a reserve list. Those selected would constitute the "active" list, and from this list would be drawn the officers for the fleet in full commission. Those not selected would be transferred to a reserve list, from which would be drawn the officers for the ships in reserve and for duty on shore.

But where shall we find a jury that will have a sufficiently intimate knowledge of the personality and record of the officers to enable it to select for promotion the most competent? Evidently the best judges are the officers themselves, who by close association and observation have an accurate knowledge of each others' fitness and ability. Hence, it is believed that the selection of the officers from each grade for promotion should be made by the vote of all the officers in the grade above. Thus the choice of the best among the lieutenant-commanders should be made by the commanders; of the best among the commanders by the captains.

Now it is evident that the number of officers and men authorized by Congress each year should be determined by the size of the fleet on the basis of the displacement of the ships. The Department should submit to Con-

gress in December of each year a statement of the total displacement tonnage of all battleships and cruisers of less than twenty-four years of age from the date of their authorization, of all scouts, destroyers and submarines of less than twenty years from the date of authorization, and also of all ships of the above classes that will be commissioned during the fiscal year beginning July 1st following. The Department should submit, also, a statement of the number of officers and enlisted men that would be necessary to man the fleet, based on an estimate of three officers and seventy enlisted men for each thousand tons of displacement.

It has been suggested that the total number of officers so fixed, each year, shall be distributed as follows: One flag officer to four captains, to six commanders, to fifteen lieutenant-commanders, and to sixty-seven lieutenants, junior lieutenants, and ensigns.

The term of service in the various grades, supposing that the graduate from the Academy is about 21 years old, should be, reckoning from July 1st of the year of graduation: For promotion to junior lieutenant, 3 years; lieutenant, 6 years; lieutenant-commander, 12 years; commander, 18 years; captain, 23 years; rear-admiral, 31 years. This would bring the line officers to flag rank at about fifty years of age.

It is proposed that the flag officers (officers qualified to command squadrons, divisions, and fleets) shall be divided into the grades of admiral, vice-admiral, and rear-admiral, in the proportion of one admiral to two vice-admirals, and to ten rear-admirals.

The scheme for determining the number of officers and men in the fleet, as outlined above, is logical and thoroughly practical, and it should receive the legislative sanction of Congress. The increase in the personnel will bear an exact relation to the yearly increase in the size of the fleet as determined by Congress. Furthermore, it will insure that the officers as they rise from grade to grade, consist of the very pick of the service—a consideration the importance of which it is scarcely possible to overestimate.

Hitherto, there has been no such co-relation between the number of ships that were authorized and the number of officers and men provided to man them, and there has been, at times, a serious deficiency, rendering it impossible to man the ships of the active fleet with their full complements.

With regard to the enlisted force, it is gratifying to find that enlistment in the Navy was never so popular as it is to-day; and there is no doubt that this is in great measure due to the efforts of Mr. Daniels, the Secretary of the Navy, to render the Navy more attractive as a career to the young men of the country. This has been done by the inauguration of a system of instruction under the officers of the enlisted men aboard ship, for which a certain period is set apart each day. "By inspiring the confidence," says the Secretary, "that they will really have the double opportunity on shipboard of mastering a useful trade, and at the same time enlarging whatever academic educational advantages they have had, we will attract the very best of our youth to the Navy. And that is what we want, young men who will enlist in the Navy for the very love of the career, combined with whatever other practical advantages and opportunities there may be that will protect them in a financial way, in case of detachment from the service, by giving them the qualifications to take up a definite line of work.

"The plan of instruction on board ship which has just become effective with a view to supply deficiencies in academic education and to providing systematic means by which all enlisted men and warrant officers who need it may receive assistance and instructions in technical branches to fit them for promotion in the Navy, or prepare them for civil trades at the end of their period of service afloat, is classified under two heads, academic and technical, or professional."

It goes without saying that the enlisted force of a navy should be citizens of the country under whose flag they serve, either native born or naturalized, and it is gratifying to learn from the last report of the Chief of the Bureau of Navigation, as shown by the accompanying table, that out of a total of 48,068 men in 1913, no less than 43,367 were native born, and 2,842 were naturalized citizens.

We conclude this chapter with two instructive tables, one showing the composition of the personnel of three leading navies of the world, on April 1st, 1913, and the other the naval tonnage built and building in the year 1913-14.

PERSONNEL OF THREE LEADING NAVIES.

	Germany.	United States.	Japan.
Total number of officers	6,353	2,966	5,246
Total number of enlisted men	60,920	47,496	42,043
Ratio of total officers to enlisted men	1 to 9	1 to 17	1 to 8
Ratio of line, engineer and warrant officers to enlisted men	1 to 11	1 to 20	1 to 9
Marine officers	170	316	None
Enlisted men (marines)	5,826	9,866	None
Total officers and enlisted men	73,269	60,617	47,289
Total number of flag officers allowed	40	18	70
Total captains and commanders allowed	351	182	292
Total other line and engineer officers	2,738	1,471	2,695
Total warrant officers	2,615	697	1,520

We draw attention in the table of personnel to the fact that for the number of enlisted men our Navy has about one half as many line officers and warrant officers as Germany and Japan. The importance of having a large reserve of officers to step into the places of those that are killed or disabled in the course of an action cannot be disputed.

NAVAL TONNAGE BUILT AND BUILDING 1913–14. (JUNE 1ST, 1913.)

	Germany.	United States.	Japan.
Naval appropriation	$111,288,618	$140,736,526	$70,302,662
Amount devoted to new construction	$52,179,113	$35,325,695	$24,144,446
Percentage devoted to new construction	47	25	34
Resultant new construction in tons	267,894	166,219	144,566
Total tons already built	365,984	763,132	471,962
Tonnage built and building	1,133,878	929,251	616,528
Dreadnoughts and battle cruisers built	14	8	2
Dreadnoughts and battle cruisers building	9	6	8
Dreadnoughts (capital ships) (7) and (8)	23	14	10
Pre-dreadnought" battleships on hand	20	24	13
Pre-dreadnought armored cruisers on hand	9	11	13
Unarmored cruisers built and building	43	15	14
Torpedo boat-destroyers built and building No. 1	130	66	60
Submarines built and building No. 2	32	46	15

Finally, we wish to emphasize the fact that because of the higher pay and better food and accommodations of officers and men in the fleet and ashore, and the higher cost of stores, provisions, navy yards, recruiting, etc., the fixed charges of our Navy are much greater than those of any other. Of the total appropriation for the Navy, 1913-1914, of $140,736,526, no less than $100,000,000 has to be expended for fixed charges—pay, provisions, recruiting, navy yards, etc.—leaving only 25 per cent, or $35,325,695, available for new construction. Germany, whose fleet is manned by conscription, does not have to set aside as we do some $40,000,000 for pay, and hence, out of her naval appropriation of $111,288,618, she is able to set aside 47 per cent, or $52,179,113, for new construction.

The Safe Aeroplane

RECENTLY the *Société Française de Navigation Aérienne* held at the Hotel des Ingenieurs Civils, Paris, a special public meeting in which the question of aeroplane safety and the prize of $80,000 offered for the invention which would most markedly advance safety, were discussed before a large audience composed of leading French experts. A translation of the most significant parts of their speeches seems especially interesting in view of the fact that the SCIENTIFIC AMERICAN anticipated and elaborated in an article on "Recent Improvements in the Aeroplane and What They Mean," on the 24th of January, on this side of the ocean, the novel points of view first revealed in Europe at that meeting.

The first speaker was Mr. Archdeacon. After criticising the rules under which the prize was offered, and after calling attention to the fact that to establish safety by tests would be inconclusive if the devices were apparently successful and a crime if they were not, he said:

"The only competition for safety which would not be absurd in theory, could not be truly called a competition for safety.

"It would be held, for instance, under the following rules:

"Apparatus for two men; speed required, 60 miles per hour. Start for all competitors on the same day, for a round trip through France, covering daily 300 miles. Repairs permitted only with the tools and materials or spare parts carried aboard the aeroplane, the time required for repairing to be counted as flying time.

"No mechanic permitted to work at the apparatus except the two aviators.

"Obligation to land on difficult grounds and on an inclosed circle of 120 feet diameter around which a rope is stretched four feet above ground, which must not be broken under penalty of disqualification.

"An analogous rule could be established as to starting on a small area.

"I see, for instance, safety in an apparatus which will not be so very different from actual aeroplanes. It needs a good motor that will never fail, *with an enormous amount of surplus power*, all carried on a machine that is extremely substantial and *permits of a great range between its highest and lowest speeds.*

"Given such an apparatus, our good pilots will fly with it around the world."

Mr. Doutre, of stabilizer fame, the next speaker, said:

"The problem of safety for the aeroplane is complicated and deals with all branches of this novel industry. All progress in any line should be encouraged, for it is from the collaboration of various inventors that the best apparatus will originate, which, progressively perfected, will finally afford a better and better relative security."

The most novel and interesting contribution was that of Mr. J. de Saint Aubin, who substantially said:

"I was happy to learn of the opening of a discussion by the Société française de Navigation aérienne for the purpose of throwing some light on the delicate question of safety for the aeroplane. This really comprises two different problems—safety on the ground and safety in flight.

"If an aeroplane has to fly fast to escape becoming a plaything of the wind and the gusts, it must land at slow speed, without losing any of its lift on that account.

"Therefore, I am compelled to proclaim the absolute necessity of varying the incidence of the wings. Such an arrangement will not only greatly facilitate landing, but its action *during flight can be depended upon for avoiding the accidents which originate from positive or negative accelerations.*

"With wings of variable incidence the pilot can, at the moment of acceleration, regulate the incidence to the speed of the moment.

"With such an arrangement *there is still needed, as a useful accessory, a rudder of enlarged surface,* in order to retain control, no matter how much the speed might be reduced. Aviation owes it to Mr. Paul Schmidt, the very intelligent French constructor, that the problem of variable incidence has entered to-day the experimental stage."

There are now really two great solutions of the problem of safety, which the Jury of the Union for Furthering the Safety of Flight may pass upon as accomplished facts—"looping the loop," and wings of variable incidence.

These mean essential progress for the art of aviation, other things (stabilizers, instruments, etc.) are only accessories.

Conserving Waste

THE reclaiming of waste material in the manufacturing industries of the country often marks the difference between a profitable and unprofitable business.

The Williamsport, Pa., plant of the National Silk Dyeing Company has recently installed the most complete system in the world for the reclamation of pure tin from the waste bichloride of tin used in weighting silk, and it is asserted reclaims a higher percentage of tin than any other dye house in the world. This liquid tin is conveyed in a concrete channel to three large settling pits outside of the dye house, each one of which is thirty feet square and twenty-four feet deep. Baffling boards prevent any current. When the water enters the first pit the tin can be seen in suspension as it settles toward the bottom. The water clears somewhat in the second pit, and the tin is found nearer the bottom.

In the third pit the tin sludge has settled entirely, and can be seen as a whitish mass at the bottom of the pit. By the time it reaches this last stage of its journey as much tin is out of it as can be taken, and the water on top runs off into the river after being purified. From Saturday noon until Monday morning of each week these are cleaned. The tin sludge is then pumped from the pits into a tank at the top of the dye house, and from there run into large presses where practically all of the liquor is squeezed out of it. The sludge is then dried into a tin dross in specially constructed ovens, and then mixed with a suitable flux, heated in a reverberatory furnace, and the pure tin smelted out of it. About sixty per cent of pure tin is recovered in this way.

CITIZENSHIP OF THE ENLISTED MEN OF THE U. S. NAVY.

	Native born.	Naturalized.	Aliens declared intentions.	Aliens resident in United States.	Aliens non-resident in United States.	Natives of—				Total.
						Porto Rico.	Guam.	Samoa.	Philippines.	
Petty officers	14,975	2,014	52	12	15	8	6	6	116	17,204
Other rates	28,392	828	62	106	265	38	71	81	1,021	30,864
Total	43,367	2,842	114	118	280	46	77	87	1,137	48,068

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Problem of the North River Bridge

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the recent agitation for a bridge over the North River, it is a remarkable fact that no doubts are raised any more as to the practicability of the long span of 3,000 feet required from pierhead line to pierhead line. It was not so when the writer first published his plans, proposing that length of span over twenty-five years ago (1888). The necessity for a single span of nearly double the length of that in the Brooklyn Bridge arises from two considerations, which, however, were not accepted as conclusive for many years.

First, the rock foundation underlying the mud bottom of the river is from 250 to 350 feet below water, making the building of piers in the river, if not impossible, yet enormously costly. One single pier in the river would have cost over seven million dollars. That amount would pay for 60,000 tons of high-class steel, which added to the steel required for a bridge with piers in the river was more than enough to build a bridge without a pier in the river.

It is real economy in this case to build the bridge with a single span.

The second reason is that the United States Government would never permit piers in the river, even if the foundations would have been favorable, because of the obstruction to navigation and to the maneuvering of large steamers in and out of their docks.

Span between towers, 3,100 feet. Height of towers, 650 feet. Width of floor, 150 feet. Capacity: On lower deck, eight steam railroad tracks; on second deck, six electric railroad tracks and one roadway; on third level, promenade.

The first design for a North River bridge, made by Gustav Lindenthal in 1888.

The plans for a single span were criticised as impracticable and unworthy of serious consideration by engineers who posed as eminent engineering authorities at the time. The attacks upon the feasibility of a single span bridge resulted in the appointment of an engineering commission by President Cleveland when Secretary Lamont was in charge of the War Department (1894). That commission, headed by the late Gen. Charles W. Raymond of the Engineer Corps of the United States Army, after a lengthy investigation, declared a single span bridge over the river entirely feasible, and this had the effect of quieting criticism thereafter.

But while this economic feature of a bridge over the North River is settled, another important feature, which also bears upon its economy, should not be neglected, and that is, that it should be built with two decks, so as to give the largest possible carrying capacity, all of which will surely be needed by the ever-growing traffic.

There should be one deck for highway traffic, which includes roadways, promenade, and track for surface, elevated and subway connections, all of which can be accommodated on one deck within the great width the bridge must have to resist wind pressure. And on a lower deck, there will be room for eight railroad tracks, over which the trunk lines in New Jersey can come into New York. The cost will not be proportionately increased, because the same width of right-of-way and the same foundations can accommodate two decks as well as one deck.

The writer had made plans for such a double deck bridge, the location and construction of which had been authorized by the Government (in 1890) from the foot of 23rd Street in New York to Hoboken and the Heights in New Jersey, as shown in the accompanying view. That location was then considered the best for the needs of both sides of the river. It would not be so now. The bridge was intended to be built with the aid of the railroads in New Jersey. But in 1900 the development of electrical traction had brought submarine tunnels, as competitors, into being. While submarine tunnels are not cheaper, track for track, than a multiple-track long-span bridge over the North River, the tunnels have the advantage that they can be built a pair at a time and can be added as needed, while a multiple-track bridge must be built to final size at once.

The Pennsylvania Railroad did not choose to wait for the other railroads in New Jersey to join it in building a bridge, but determined to come in alone in tunnels to a station below ground, to be connected by tunnels under the East River also with the Long Island Railroad system. This fact stopped the building of a bridge across the North River for the time being.

In the meantime, the improvements in automobiles have been so rapid as to transfer this former vehicle *de luxe* for persons into the vehicle of greatest necessity for street commerce. All street vehicles are now carried across the North River in ferries.

The demand for swifter vehicle communication between New York city and the New Jersey territory opposite becoming louder and more urgent, has led to the demand for both tunnels and a bridge for highway traffic; but the equally urgent needs of the railroads have not yet been considered, mostly for the reason, it appears, that the entire project is yet in an embryonic condition, and has not yet been thoroughly studied. Another reason is that the railroads just now are struggling, under hostile legislation, for their very financial existence, and are not in a condition to assume new burdens of construction, no matter how much needed. But this condition cannot last forever. Saner views among the public and the law makers will ultimately prevail, so that the normal growth of construction and commerce will again go on.

In the meantime, the railroad freight terminal problem in Manhattan is before the city authorities awaiting solution. It requires the crossing of the river with railroad tracks either through freight tunnels or over a bridge. A careful study of that freight problem will make it appear that the crossing over the bridge will be cheaper than through tunnels which would have to be nearly three miles long with heavy grades in them.

The bridge proposition would then present itself in the following form:

Let the cost of a durable two deck bridge, extending from Ninth Avenue and Fifty-seventh Street in Manhattan to the Boulevard on the edge of the Palisades above the West Shore Railroad tunnel in New Jersey (8,330 feet long) be estimated at seventy-six million dollars, an ample amount (if built by private capital) to cover cost and contingencies of construction, right of way, cost of financing and interest during a construction period of seven years. The annual fixed charges would be:

For interest 4 per cent	$3,040,000
For sinking fund ½ per cent	380,000
For maintenance, taxes, administration	580,000
Total	$4,000,000

One half to be assumed by the railroads and one half by the two States.

The railroads' contribution of $2,000,000 to come from tolls, based upon traffic agreements. The share of each State ($1,000,000) to be paid in the form of a rental under an agreement running for the length of the amortization period (say fifty years). Payment of rental to commence only after completion of bridge. The two States would be entitled to the income from tolls on automobiles and from all local transit cars passing over the rapid transit tracks on the upper deck. For all other street traffic the bridge shall be free, the same as the East River bridges.

The revenue from wires and cables, belonging to telegraph, telephone and electric power companies, (not including those for the railroads or any service on the bridge) and from other sources to be equally shared by the railroads and the two States.

There is very little doubt that on these conditions the bridge can be built by private capital on condition that, when the cost of the work shall have been amortized, the tolls and rentals from railroads and communities shall be only enough to pay for maintenance, administration and taxes.

The great economy of a double-deck bridge over a purely highway bridge is apparent without further argument. Its construction without public funds is not only feasible, but highly desirable and advantageous from every point of view; because it can be built cheaper, better and quicker with private capital than it can be done as a work depending upon public funds. The excessive cost and wastefulness of our public works is proverbial. It seems as if it cannot be helped under our systems of city and State administrations. When the writer was Commissioner of Bridges of this city, he found it impossible to get construction work done at the same low prices as, for instance, railroad work of the same class. Many other conditions over which engineers have no control contribute to the excessive cost of work with public funds. Everyone of the four existing East River bridges cost 80 to 120 per cent more than the original estimates at the time they were authorized.

The share of the rental of one million dollars from each side of the river would commence only after the bridge is completed, and then it would hardly be felt by the tax payers within the benefited area in each State. In a few years the tolls from the local transit lines over the bridge would cover that rental, so that the taxpayers would then be fully relieved from paying anything. In contrast to such a condition of financing, observe the experience of the city of New York with the ferries to South Brooklyn and Staten Island. There is now a deficit of nearly $900,000 a year (it was $896,214.18 in 1912) on the operation of those ferries, which has to be covered from general taxation. The present prospect is that this deficit will not become less, but that it will be permanent and growing. The more passengers those ferries will carry, the greater will be the deficit. And a similar condition would probably be in prospect for a North River bridge built with public funds.

Although the traffic over the North River bridge would be ten times as large as to South Brooklyn and Staten Island, there would also be greater expense for maintenance and operation.

There is sufficient experience on hand to warrant the view that the cost of that bridge built with public money would be indeterminate, and that its administration would become a duplicate of the deficit-producing Staten Island ferries, before which the city stands helpless.

It is only necessary that the railroad interests combine with the local communities for the construction of the bridge with private capital. With a little patience and educational work it can be proved, because it is susceptible of proof that the bridge will mean a decided economy in the transfer of railroad freight as compared with the present method of carfloats.

The freight terminal problem and the problem of local freight distribution is now proposed to be studied and worked out by experts for the city administration, with the aid of the Chamber of Commerce and the Merchants' Association of New York city, who have for years endeavored to have the subject thoroughly prepared, so that all future improvements for the harbor and shipping shall be done on a unified plan, of which the bridge over the North River will be an essential feature.

GUSTAV LINDENTHAL.

New York.

Protection From X-rays in Radiography

The Devices of Dr. Maxime Ménard

By Jacques Boyer

X-RAYS are exceedingly dangerous to scientists or doctors who are exposed to them, either daily or for single prolonged periods. The redoubtable emanations of the X-ray tube cause "burns," located, for the most part, on the hands of the operators. (Fig. 1.) This is due to their exposed position in radioscopic examinations. At times X-rays cause organic lesions of a deep-going character, necessitating, for example, the amputation of a finger or surgical interference of the face or forearm; they may even cause the death of professional manipulators in a relatively short space of time.

Dr. Maxime Ménard has succeeded in remedying this hazardous state of affairs. Thanks to special appliances and gloves capable of absorbing the most penetrating X-rays, he insures not only the absolute protection of the hands of the operator, but also that of the rest of his body. Indeed, the radiographic-room recently installed at the Cochin Hospital, according to the specifications of this erudite physician, is well worth a visit. Let us examine, in succession, the three principal constituent parts of this unique installation, (*a*) the sources of the high tension current supplying the X-ray tubes, (*b*) the protective devices of the apparatus for exploration and examination, and (*c*) the tubes generating the rays.

In Dr. Ménard's installation we find two units for the production of X-rays. One of these, used for radioscopy,* consists of an induction coil and an interrupter mounted, with certain accessories, on an oak stand. (Fig. 2.) The other, called the Gaiffe rotary commutator, contained in the cabinet on the left in Fig. 2, consists of a high tension, step-up transformer of the usual commercial pattern, furnishing an enormous difference of potential (160,000 volts) and a high tension rectifier transforming this alternating current into a continuous one which is supplied directly to the X-ray tubes.

We will now enter somewhat into detail with respect to each of these sources of current. The parts of the first are specially designed to withstand the formidable difference in potential obtained in the secondary winding of these coils, corresponding to a spark-gap of 30 to 35 centimeters. It is especially necessary to use an interrupter of particularly sturdy construction, such as the Blondel-Gaiffe mercury turbine. The principal part of this piece of apparatus consists of a cone with multiple perforations, its lower extremity dipping into mercury. Upon its axis a motor is mounted. The whole is fixed to a metal cover fitted to a cylindrical tank inclosing the apparatus and hermetically sealed by a rubber gasket. This tank is fitted with two taps for the introduction of the gaseous dielectric. When the cone revolves under the impulse of the motor, the mercury rises, by the action of centrifugal force, in the oblique channels of the cone and flows from nozzles in the form of a liquid conducting jet which periodically opens and closes the circuit of the coil with a frequency of 42 or 84 interruptions a second, according to the adjustment.

Besides this, in order to break currents of such considerable volume (50 amperes on the average) these interruptions take place in an atmosphere of illuminating gas which cools the ensuing sparks, and thus prevents the destruction of the metallic blades upon which the mercury is projected.

As to the Gaiffe induction coil, this is about 60 centimeters high and weighs 65 kilogrammes; its windings are submerged in a hydrocarbon insulating fluid of enormous electric rigidity, since a layer 5 millimeters thick of this dielectric resists a tension of 45,000 volts. Moreover, by reason of its viscosity, this substance retains its dielectric qualities to a remarkable degree, in spite of elevations of temperature during the course of operation.

Under these conditions, M. Ménard is able to traverse X-ray tubes with currents of 2/100 of an ampere with a difference of potential of from 70,000 to 80,000 volts. This enables him to make radiographs, as a matter of routine procedure, in a few seconds. But when the necessities of hospital practice demand it, this skillful practitioner turns to the Gaiffe rotating commutator, inclosed in a sort of cabinet (Fig. 2), which enables him to reduce the time of exposure to the fraction of a second.

This cabinet conceals within its interior a miniature electric plant (diagram, Fig. 3) of which the principal units are a high tension step-up transformer *T* and a commutator *M*. The first of these pieces of apparatus, inclosed in a tank of galvanized metal, connected with the terminals *AA'*, transforms the current furnished directly by the alternating circuit and gives to the secondary a tension of 160,000 volts, corresponding to a spark-gap of 30 centimeters. Above the transformer, insulated in the same manner as the induction coil described above, revolves the commutator which rectifies the alternating current. For X-ray tubes should always be fed with a continuous current in order to avoid causing their rapid deterioration.

The synchronous motor *M*, which revolves the commutator, turns with a speed exactly corresponding to the periods of the alternating circuit; consequently, the instant the alternating current reverses its direction, the mechanical rectifier makes its connections with the transformer and the tube in such fashion that the current does not change its polarity on the working circuit (i. e., through the tube). The only fittings projecting from the cabinet are the two large insulated columns, traversed by the high tension wires which it suffices to connect directly with the X-ray tube. A milliampere-meter, connected in series with the tube, permits measurements of the volume of the circulating current.

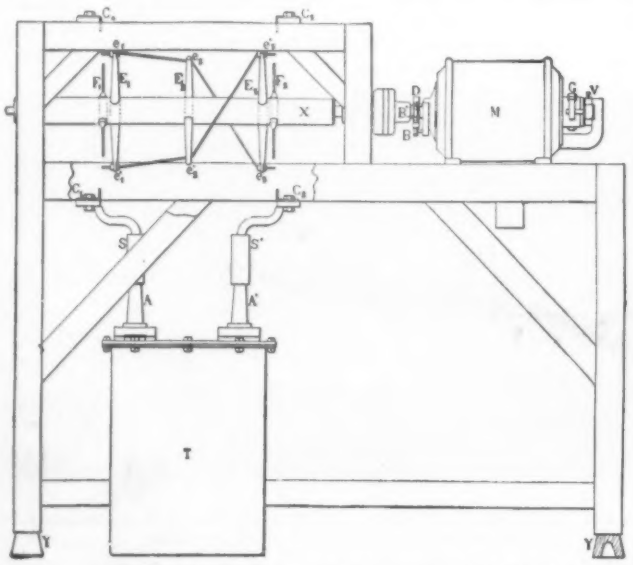


Fig. 3.—Diagram of the Gaiffe rotary commutator contained in the cabinet situated at the left in Fig. 2.

T, transformer; *AA'*, terminals; G_1, G_2, collectors for the rectified current; *M*, synchronous motor; *Y*, shock absorbers; *D*, collector for the clutch indicator.

The marble slab mounted on the side of the cabinet seen in one of the engravings (Fig. 2) is used for cutting-in the synchronous motor which actuates the rotary commutator. As to the screen seen on the right of the same picture, this carries the regulating rheostat and serves, at the same time, to protect the operator from the X-rays emitted by the tube. Besides this, a device, termed an automatic cut-out (controlled by a special clock movement which permits the turning on of the current for periods of from 1/5 to 8 seconds as desired) completes the installation.

When it is desired to take a radiograph it is sufficient to close a switch, and the clockwork automatically breaks the circuit as soon as the time determined upon by the operator has elapsed.

Let us now describe the accessories of the radiographic installation of the Cochin Hospital, namely, the supporting standard of the X-ray tube and the exploratory apparatus. Inasmuch as the tube must be susceptible of being placed in any position whatever, so that it may be directed upon all parts of the body, according to the necessities of treatment, its supporting standard is a rather complex piece of apparatus, requiring perfect mechanical construction. In order to protect the operator, the tube is inclosed in a hemispherical shell of insulating material, opaque to X-rays. Metal plates cannot be used to absorb X-rays, in the vicinity of the tube, by reason of grave electrical disadvantages. It has been therefore necessary to turn to insulating materials, such as India rubber, in which heavy mineral substances have been incorporated, showing great opacity to X-rays. This protective shell serves also to carry limiting accessories which serve, when treating a patient, to confine the irradiation solely in the affected part, while protecting the rest of the body. These localizing devices terminate in tubes of crystal, opaque to X-rays, which bar the lateral passage of radiations while permitting the surgeon to observe the part to be treated.

In spite of the considerable weight of the protective shell, the displacement of the tube can be controlled from a distance with the greatest facility by reason of the perfect balancing of the whole. A diaphragm may also be mounted upon the shell which limits the passage of the rays to an opening, variable at will. The control of the diaphragm aperture is effected by means of a flexible connection whose extremity is within reach of the hand of the operator. Thanks to this disposition, the operator is enabled to make all radioscopic observations with a maximum of security. Besides this, a system of barrel springs supports the fluorescent screen upon which the shadows of the viscera are projected and balances exactly its weight. The arm for supporting this screen can be seen at the upper part of the tube standard (Fig. 4).

As to the table upon which radiographs are taken, or radiotherapeutic treatments administered (Fig. 5), this is a simple wooden table which presents the only peculiarities of having an inclinable back-rest and metallic attachments for immobilizing the patient.

But let us now come to the most original part of the radiological service of the Cochin Hospital, the protective device, designed by Dr. Ménard and of which we will borrow the description from the recent communication of this clever practitioner to the Academy of Sciences in Paris. This very ingenious apparatus consists essentially of three panels covered on the inner surfaces with sheet lead of a minimum thickness of four millimeters. Mounted upon a base, they form two wide dihedral angles in whose interior is placed the patient to be examined as well as the Crookes tube.

As is readily noted in the engraving (front page), the central panel is composed of three parts: 1. The fluorescent screen. 2. A movable lead screen. 3. A stationary lead screen. The first can be displaced vertically in grooves, like a sash, by the use of counterweights; the movable lead screen is arranged in like manner and can accompany the fluorescent screen in its movement, or can, on the contrary, be moved away from it.

This mobility of the two screens allows palpation of the patient's abdomen (Fig. 7) and, when once the palpation is concluded, they may again be brought into contact with each other. The patient is placed upon a very easily revolvable platform which the radiologist turns, according to his desires, in order to examine the patient in all pertinent ways. In addition, the fluorescent screen is provided with a covering of lead glass of thickness sufficient completely to absorb Roentgen rays. Finally, this apparatus, which assists the vision of the radiographer because it screens entirely the luminous tube, permits the radiography of the patient in the erect position by reason of the easy substitution of the radiographic plate-holder for the fluorescent screen.

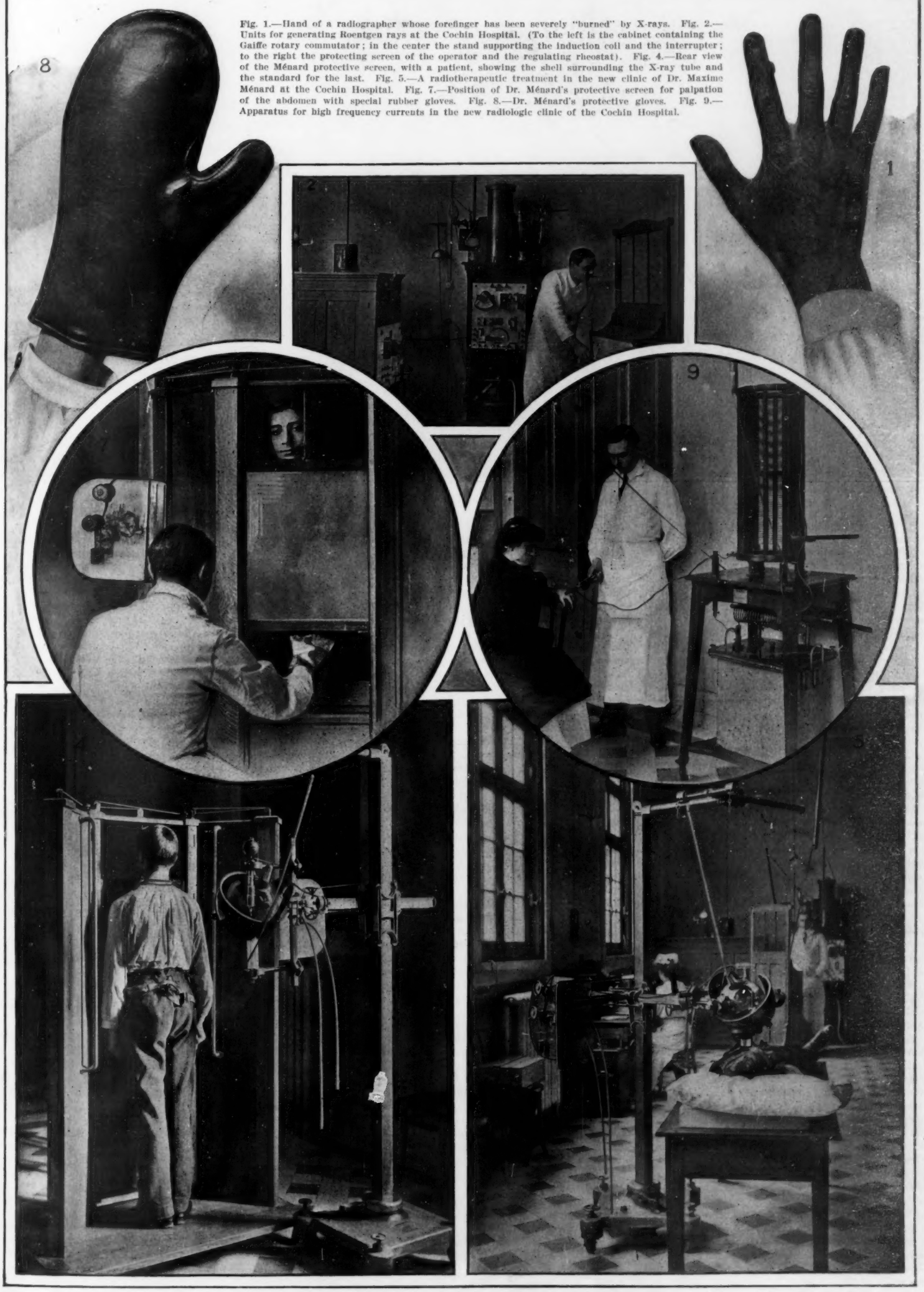
Besides this, M. Ménard has devised protective gloves of an India rubber base combined with metallic salts of high atomic weight (85 per cent of lead compounds) (Fig. 8). With these gauntlets, four millimeters thick, not only the hands, but the wrists of the operator are completely protected from X-rays.

We will now finish our visit to the radiographic clinic of the Cochin Hospital by referring to the X-ray tubes used in this institution. For use in prolonged radioscopy and for radiotherapy, tubes are employed of a capacity of one milliampere; their anticathodes are made of platinum plates upon which the cathode rays are focused. The energy produced by the high tension current is concentrated, in consequence, upon the anticathode, whence an elevation of temperature of considerable degree results, even with currents of very slight

(*Concluded on page 318.*)

* Radioscopy is the term applied to the direct X-ray examination of a part of the body by means of a fluorescent screen. Radiography is the process of taking an X-ray picture by means of a photographic plate.—EDITOR.

Fig. 1.—Hand of a radiographer whose forefinger has been severely "burned" by X-rays. Fig. 2.—Units for generating Roentgen rays at the Cochin Hospital. (To the left is the cabinet containing the Gaiffe rotary commutator; in the center the stand supporting the induction coil and the interrupter; to the right the protecting screen of the operator and the regulating rheostat). Fig. 4.—Rear view of the Ménard protective screen, with a patient, showing the shell surrounding the X-ray tube and the standard for the last. Fig. 5.—A radiotherapeutic treatment in the new clinic of Dr. Maxime Ménard at the Cochin Hospital. Fig. 7.—Position of Dr. Ménard's protective screen for palpation of the abdomen with special rubber gloves. Fig. 8.—Dr. Ménard's protective gloves. Fig. 9.—Apparatus for high frequency currents in the new radiologic clinic of the Cochin Hospital.



Various apparatus and accessories for use in protecting scientists or doctors when exposed to the X-rays. The apparatus here shown is to be found in the Cochin Hospital at Paris.

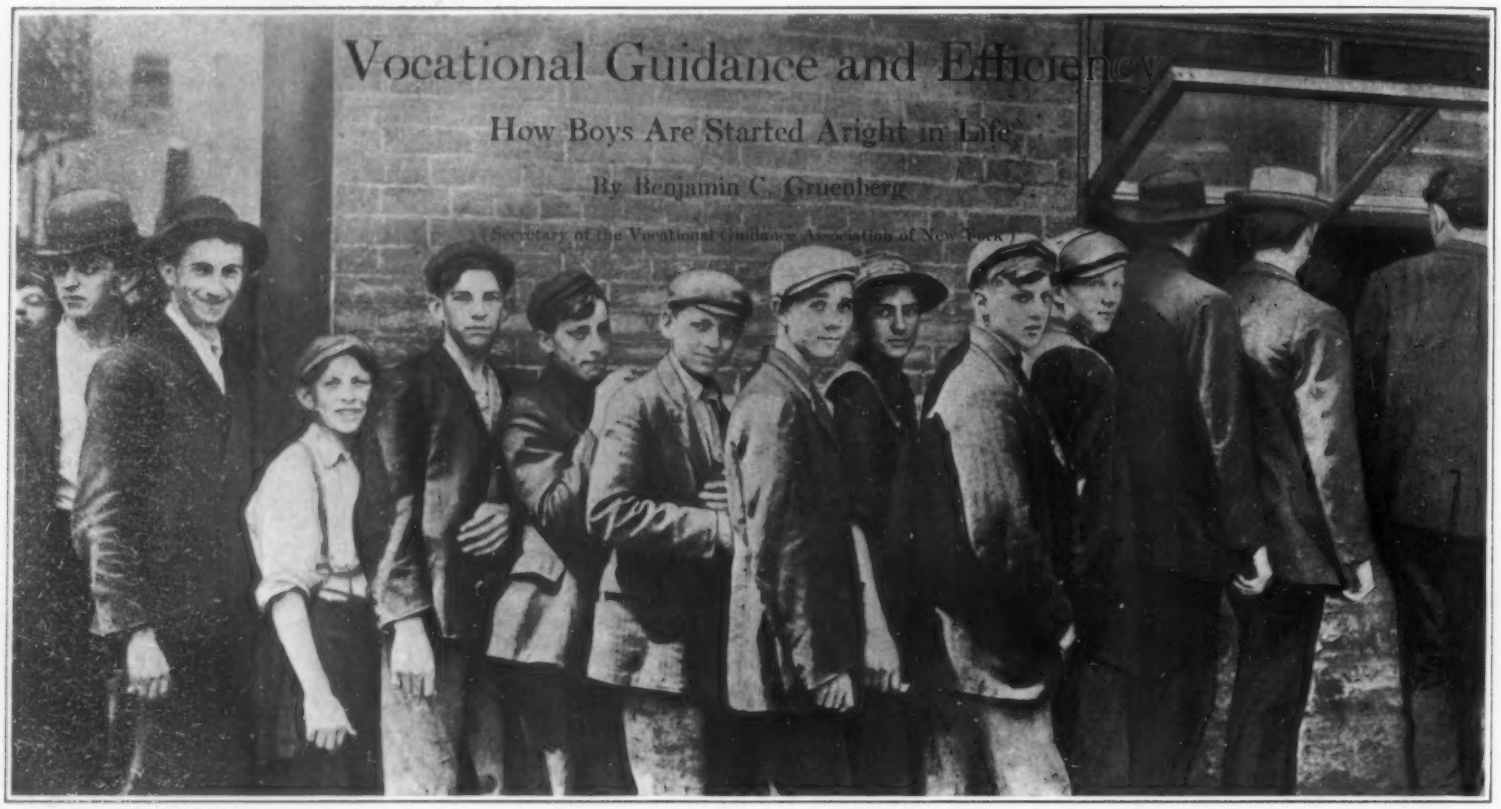


Photo by National Child Labor Committee.

The line of applicants at an Indianapolis factory.

A PAPER-GOODS factory that employs 200 workers, takes from 250 to 300 new employees or "learners" every year. This means that a large part of the cost of operation goes into training workers, or rather "breaking in" workers who do not stay long enough to repay this charge. In a certain large department store that employs regularly 1,000 workers, only about a fourth of the employees remain in the service as long as one year; the average length of service for the rest is about 14 weeks. In a wire factory employing 150 women workers, 450 to 500 "learners" are taken on every year.

An elementary student of arithmetic can see that there is something wrong in these establishments; but these establishments are not exceptional—they are typical. Yet neither the elementary student of arithmetic nor the "average business man" has taken the trouble to find out just what it is that is wrong. The latter has been inclined to blame the schools for sending him "inefficient" boys and girls, and the moving picture shows for making the workers restless, or the "agitators" for making them dissatisfied. The girls and boys for the most part have been too dazed to blame anyone. Perhaps more is to be gained in other ways than in looking for someone to blame.

It is true, to begin with, that the army of girls and boys that leave the elementary schools in the sixth to the eighth grades are extremely "inefficient" from the point of view of their prospective employers. But I am not ready to admit that the demands of these employers should be met by the schools. More than half the children leave at or about the age of 14 years, that is to say, as soon as the laws of the various States allow them to. At this age, most girls and boys are not sufficiently mature either physically or mentally to apply themselves to the sort of routine work that is generally offered to the beginner or the "learner" in most industrial or commercial establishments. That a few of them stick to the first job and work out of it into some sort of a career is fortunate for those few, but is no fair criterion of what we have a right to expect from the many. Nor is it an indication of what opportunities industry offers them. The fact is that most intelligent employers do not care for the young girl or boy; the cost of breaking him in is too great. As a result, the only kinds of work that these young people can get to do are those which are "easy to learn" by watching others, or by being shown once or twice. But these are just the tasks that lead to nothing; in a few short years the girl becomes a young woman, the boy becomes a young man, both without having acquired industrial skill or insight sufficient to bring in a living wage—and they become drifters or even unemployable. That this situation is extremely wasteful from an industrial point of view has been manifest to thoughtful business men for many years. One of the forces back of the movement for industrial education is just the recognition of the waste of potential in the drifting of the untrained workers.

A more dynamic recognition of this waste is to be seen in the scientific management agitation. Scientific management carries a promise of a new industrial revolution—not because it has already brought about an immense increase in the productivity of labor, but because its assumptions and principles are radically different from those upon which most industry in the past has been carried on. Since the beginning of the industrial revolution brought about by the introduction of machinery and factory methods, managements have depended upon expensive machines and cheap workers to produce profits. Closer competition has simply meant the refinement of machinery, the greater division of labor and the speeding up of the worker. Scientific management goes beyond this stage of industry, for it involves almost consciously a social revolution; it has become aware of the "human factor." It has discovered that whereas an individual pioneer may exploit the soil or the forest and leave future generations to take care of themselves, the community as a whole—since its life transcends that of the individual—cannot afford to do so; and it has become active as "conservation." It has discovered that whereas the individual exploiter may squeeze the blood from two or three successive gangs of workers, the railroad, or the manufacturing corporation, which transcends the lives of the individual workers, may not operate on this basis.

The ordinary manager gets what workers he can, any way he can, extracts whatever services from them that he can, and then replaces them with other workers. Scientific management undertakes not only to train each worker for his particular task; it undertakes to select each worker for the particular training. The task of the employment manager is no longer that of counting off so many hands from among the applicants; it is virtually to select pupils for special training within the works or store. It is an application to the human material of the scientific management principle of "efficiency of distribution." It recognizes the fact that to be good economically, a man must be good for *something;* and that one man may be good for one thing and quite worthless for another. It seeks then to put each worker where he will do the most good.

The work of the expert to redistribute the workers in industry is necessary because the workers have come to their jobs in the most haphazard way. This means great economic waste inasmuch as there is a great deal of drifting and shifting, inasmuch as there is a great deal of "internal resistance" involved in the fact that people are trying to do work for which they are by nature *unfitted,* inasmuch as the work lacks enthusiasm. But a still greater waste is involved inasmuch as the casual worker is not a happy worker, does not get from his work those esthetic and emotional satisfactions that distinguish men from machines and donkeys; and the worker who has not found his particular work *is* a casual worker. But this means most of the workers. Economic efficiency, as well as the higher social efficiency, calls for a more effective distribution of the workers.

The vocational guidance movement, which began to take on a definite form with the work of the late Prof. Frank Parsons (who fished for talents among the young people that patronized the Civic Service House in Boston), has expanded rapidly in a few years and seems now to offer a satisfactory basis for bringing together various forces that ought to work together but that have not been able to find a common working basis. The work started by Prof. Parsons is now continued by the Vocation Bureau of Boston under the direction of Mr. Meyer Bloomfield. In co-operation with employers and with the school system, this form of social service is rapidly assuming a prominent place in the activities of a progressive community. The business man who wanted the schools to give him ready-made office boys and machine operators may find that he can help the schools to giving him something even better. The school man, who was naturally suspicious of the clamor for "industrial education," may find that it is possible to reorganize the school to meet the new demands without losing any of the ideals for which he has stood—indeed, with a good prospect of strengthening the hold of his ideals upon the whole community.

Like all new ideas—like the efficiency movement itself—vocational guidance is exposed not only to a great deal of misapprehension, but also to a great deal of misapplication and abuse. Thus, the phrenologists and astrologers, pressed by science and the spread of education, find in it a new lease of life; for they can add a new high-sounding phrase to their armament of flub-dub and quackery. Or an old-fashioned exploiter looking for the latest wrinkle finds in vocational guidance a quick way for reducing the fee he is perforce obliged to pay to the employment agencies. But vocational guidance is neither an application of astrology nor a substitute for the employment agent. It is simply an attempt to introduce organized knowledge into a field that has been too long left to empiricism and blind chance. It is the effort to give the individual the benefit of competent counsel in the matter of directing his preparation for his major work in life.

Every reader is familiar with the street car conductor who ought to be an opera singer or statistician; you know the physician too, who ought to have become a plumber. Both lacked guidance in making their plans from year to year, while they were young. Surveys made in several cities during the past four or five years have brought out the fact that much of the drifting and floundering can be charged directly to the schools. This is true not because the schools have been inefficient in doing their special work; on the contrary, they have been increasingly efficient in this work for many years past. But the schools have been remiss in that they have not with sufficient alacrity adapted themselves to the changing conditions of social and economic life. Nearly three fourths of the children who leave school when the law allows, do so not because of direct economic pressure in the home, but because the school has lost its grip upon the children. This is to be explained by the fact that the schools continue to give to all the children just that particular pabulum which was satisfactory a generation or two ago to a small fraction—a selected fraction—of the children. But the mass of the children are different from that selected fraction in just this, that they are thing-minded, motor-minded, not word- or symbol-minded, like their teachers.

The result of this failure of the schools shows itself not only in its inability to hold the pupils, not only in the drift and waste of the best years of the children's lives, not only in the subsequent inefficiency—both civic

(Concluded on page 318.)

Guns on Aeroplanes

By John Jay Ide

AT the last Aeronautic Salon in Paris were shown several aeroplanes equipped with Hotchkiss quick firing guns. In almost every case, however, the firing arc was extremely limited owing to interference by parts of the aeroplane. Exception may be made in favor of the gun mounted on the Borel monoplane, which had its bow clear owing to the rear position of the propeller. Here again, however, there was an objection in that the gun had to be operated by the pilot, the passenger being placed behind.

The invention of M. Loiseau seems to solve the difficulty of fitting guns to present day monoplanes. As shown by the accompanying photograph, the arrangement consists in attaching the gun to a support braced to the mast and fuselage. The support is high enough to enable the gun to fire over the tractor even with considerable depression. The marksman is protected in front with a shield of four-millimeter armor, and has a light railing at the sides and rear. Granting the efficacy of the shield, the position of the passenger is an extremely exposed one. Also the pilot's view is somewhat interfered with notwithstanding the small sections cut out of the trailing edges of the wings adjacent to the fuselage, which allow him to see the ground. On the whole, however, the gun placing is the most satisfactory possible in tractor screw monoplanes.

The aerial marksman in action.

The mitrailleuse is fitted to a military type two-seated Deperdussin. Trials commenced February 10th at Villacoublay, near Paris, under the control of Capt. Destouches of the French army. The pilot, Prévost, took up a mechanic to act as marksman. On February 14th the trials were renewed, this time under the observation of Gen. Bernard, Col. Estienne, and several other army officers of high rank. The passenger-marksman was the inventor, M. Loiseau. He operated the gun while the monoplane was on the ground, in full flight and gliding. The accuracy of the shooting while in the air was not remarkable, but it is a mere matter of time before that is obtained. The practicability of operating a gun in this position was fully proved.

A Self-steering Farm Motor

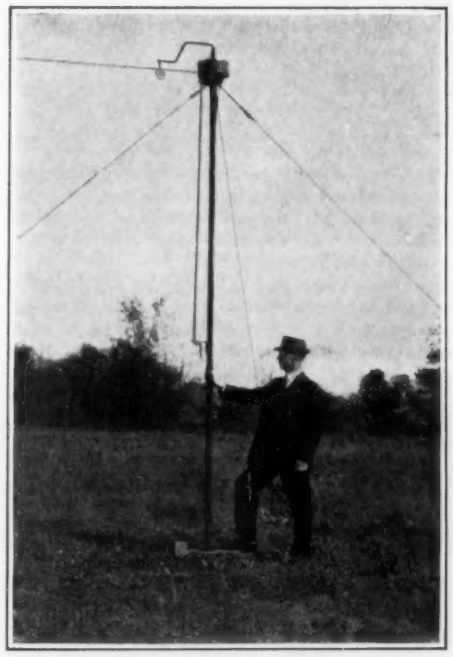
By Herbert I. Washburn

THE application of the gasoline motor to agricultural work is of great interest to inventors at the present time. A solution of the question has been obtained for the big farms of the West in the form of the gasoline tractor, but this does not meet the requirements of the irrigated truck farms and gardens of the Eastern and Southern States.

The great need of the country is an efficient helper for the owner of the one-man farm; a machine that will work effectively and make him less dependent upon hired help. No hand steered machine can meet this requirement because the expense of the operator takes $500 per year off the profit of the farm. This was unavoidable with the use of the horse as motive power, but as the gasoline motor is an automatic power source, its correct use requires automatic steering.

Here is a system which has been worked on a practical basis by the writer. It requires compliance with certain mechanical conditions. The farmer who wishes to make use of it must be willing to abandon the old traditions of extensive farming. He must be willing, if necessary, to sell the hillside farm inherited from his grandfather and lay out a new farm to meet those conditions. This is an easy matter with young men just taking up intensive farming, and with those migrating to new localities.

The farm must contain one or more circular areas of any size, up to about ten acres each in area, reasonably level, and irrigated preferably by the tile system. Thus, a farm in central Florida would consist of the usual ten-acre square, with a seven-acre circle in its center, the remaining corners, three acres in area, being occupied by fruit trees, buildings, etc. In the center of the seven-acre circle, the center post shown in the accompanying photograph would be permanently installed. At the top of this post, which is strongly guyed, is seen an iron drum. This drum is indexed and locked by the small handle on the side of the standard. Attached to the iron drum is a slender steel wire, tempered and tin coated. This wire passes through the guide pulley shown, and then



Center post about which the tractor runs.

to the steering lever of the implement some distance away. At each revolution of the implement around the field, the wire wraps once around the drum, hence the circumference of the drum determines the swath of the implement. Between the frame and the steering lever of the implement a strong spring is attached tending to steer the implement away from the center post. The steering wheel has a deep flange in order to resist side pressure and is mounted in a ball-bearing head. About two pounds pressure at the end of the steering lever is sufficient to guide the implement. Since the tension of the steel spring (and of the steering wire opposing it) is about fifty pounds, the steering lever is obliged to follow an exact spiral path.

Gasoline tractor that runs a spiral course without an attendant.

Repeated runs with the experimental implement shown in the accompanying photograph, starting at a radius of about 200 feet and finishing about 20 feet from the center post, showed no visible variation from the path first struck out. A plow jointer was used to indicate this path. A door check was made use of to prevent any undue vibration of the steering lever. The slight dancing of the steering wire was desirable, as it obliterated the last vestige of friction in the steering head.

The framework of the implement is intended to be such as will facilitate the attachment of all the devices used in row-crop farming, such as plows, ridgers, cultivators, sprayers, etc. Also conveniences for use in connection with hand steering, such as mowing bar, carrying rack, etc.

An improved style of implement has been designed having motive power applied to both rear and forward wheels, both wheels being pivoted so as to work between closely set rows of plants. About 90 per cent of the weight of the machine is on the two drivers, giving a strong adhesion. The remaining 10 per cent weight is on the wheel at the end of the beam. The height under the beam is about three feet, permitting the cultivation of truck, tobacco, cotton, etc., of that height. A safety device is provided to stop ignition in case of breakage of the steering spring or wire.

The steering action of the tractor was found to be very dependable in the experimental runs, requiring no attention whatever. The unwinding of the wire from the drum is accomplished while the implement is being run out of the field by hand steering. The steering wire is then suspended ready for use at the next operation. With a dependable gasoline motor, having a positive lubrication, etc., two six-hour runs per day, without an attendant, are possible, placing the farmer on an equal footing with the manufacturer, with his automatically-fed, power-driven machines.

Fodder Equivalents

COMPARATIVE tables of the nutritive value of various foods, and the proportions of proteids, fats, and carbohydrates they contain, have long been available for students of human dietetics. That similar tables would be equally valuable to breeders of domestic animals is obvious. According to *La Revue* (Paris) such tables are now furnished by Prof. Mallevie, who holds the chair of zootechnology in the National Agronomic Institute of France.

"For the first time we are in possession of fodder equivalents. We now have a precise knowledge of the value to horses or cattle of definite quantities of hay, straw, clover, flax-seed cake, and beets, in what measure they can be substituted for each other to attain the same result and what economy or other advantage may result from such substitution."

M. Mallevie shows that 6 pounds of meadow hay give the same alimentary result as 12 pounds of wheat-straw, 2¾ pounds of wheat bran, 22 pounds of beets, 5½ pounds of clover hay, or ½ pound of flax-seed cake.

"These figures indicate what he calls the unit of fodder. His table shows how, in default of one equivalent, another may be used without inconvenience, quantities being combined according to circumstances."

Breeders will thus be enabled to compute profits more definitely, and can find by experiment what food gives the largest returns in meat, milk, butter, etc. With reference to its cost, it should be remembered, however, that two animals fed on the same ration may vary in power of assimilation, so that one will extract better results per kilo than the other.

Duplicating Charts by Zincography.—The United States Hydrographic Office has recently installed a plant for the reproduction of foreign charts by zincography. The hydrographer states in his last annual report that this work will occupy at least four years, but when it is completed the Navy will be practically independent of foreign sources of supply for charts.

A Great Telescope for Canada

THE Canadian government will soon possess a more powerful reflecting telescope than any now in existence. It has been referred to in the newspapers as "the largest telescope in the world," but this description is misleading for two reasons; first, because its aperture, 72 inches, is to be the same as that of the famous Parsonstown reflector, built by Lord Rosse in 1842; and second, because by the time the Canadian instrument is completed it now seems likely that the 100-inch reflector which has long been under construction for the Mount Wilson Solar Observatory will also be ready for use. The Canadian telescope will, however, be a much more efficient instrument than Lord Rosse's. Not only will the mirror be much superior, but the mounting will enable the telescope to be worked to the full advantage. The Parsonstown reflector has an altazimuth, not an equatorial, mounting, and is operated under such difficulties that comparatively little use has ever been made of it.

Contracts for the new telescope have just been awarded to J. Brashear for the mirrors and other optical parts, and to Warner & Swasey for the mounting. The disk for the principal mirror will be made by the St. Gobain glass works, in Paris, but all the grinding and figuring will be done in this country. The total cost will be nearly $100,000. Inasmuch as the instrument is intended primarily and notoriously for work of no immediate practical benefit, viz., the spectrographic measurement of radial stellar velocities, this sum represents a very notable contribution to pure science on the part of a government.

The telescope will have a parabolic mirror of 72 inches clear aperture and 30 feet focal length, with a central hole 10 inches in diameter. The mounting is to be similar to that of the Ann Arbor and Melbourne reflectors, with a skeleton tube at one side and nearly midway between the bearings of the long polar axis, the balance being restored by the declination motion mechanism and by counterweights at the other side. Both polar and declination axes will be carried entirely on ball or roller bearings, in place of the usual plain bearings for collimating and a complicated system of counterweighted rollers for relieving the friction. The construction will also be simplified in other respects, e. g., all fine circles will be omitted, as will the slow motion arm in right ascension. It is characteristic of twentieth century technique in astronomy that, although the new telescope will have a full set of oculars for visual observations, no programme of visual work is contemplated. Nowadays the camera takes the place of the human retina. The main purpose of the instrument will be the measurement of motion in the line of sight of stars fainter than the fifth magnitude; a task beyond the light-gathering power of nearly all existing telescopes. For such work the telescope will generally be used in the Cassegrain form; the light from the main mirror, converging toward a focus, will be received by a second hyperboloidal mirror of about 19 inches aperture and 10 feet focus, placed about 23 feet above the main mirror. The light passes thence down through the hole in the main mirror, and the star images are formed about three feet below the latter. Here the spectrograph will be placed. For the fainter stars of low dispersion the spectrograph will probably be placed at the prime focus. An investigation of the atmospheric conditions in different parts of Canada is now in progress, to determine where the telescope will be located.

Nebuchadnezzar as a Builder

By Edgar J. Banks

PROBABLY the greatest builder the world ever had was Nebuchadnezzar, King of Babylon from 604 to 561 B. C. There is hardly a ruin in Babylonia which does not show traces of his work. Nearly everywhere in Mesopotamia, and even in Persia, are found bricks bearing his name. He delighted in restoring the old temples. He surrounded defenseless cities with walls and moats. He confined the rivers to their courses with huge brick embankments. Shortly before his time Babylon was completely destroyed, and its foundations were scraped into the river, but he rebuilt and enlarged the city. The temples with which he adorned it amazed even the travelers from distant Greece. The walls surrounding it were one of the seven wonders of the ancient world. Fortunately it was Nebuchadnezzar's custom, whenever he built or restored a temple, to write a long description of his building operations upon a cylinder of clay, and to bury the record in the walls that future generations might read of his work. His wish has been fulfilled, for during the past two years several of the cylinders have been discovered by Arabs, and have found their way to Europe and America.

One of the last of the cylinders to appear, and now

A finely molded burned clay cylinder of the great builder, Nebuchadnezzar.

The inscription is in three columns, with 145 lines of cuneiform writing, and so well preserved that every one of the fifteen hundred wedge groups is perfect.

in the possession of the author, was discovered by Arabs in a ruin called Wana-Sedoum, or more correctly Wannet es-Sa'dun, a day's journey to the south of Babylon on the Euphrates River. It mentions the ancient name of the place as Marad, and thus another city is added to the map of ancient Babylonia. The cylinder is really a truncated cone, 8½ inches high and 18 inches in its greatest circumference. It is of finely molded clay thrown upon a potter's wheel, and built up as if it were a vase without a bottom. The interior walls distinctly show the finger marks of the ancient potter. The walls are very thick. After the cylinder was inscribed, it was burned until the clay resembled a compact sand-colored stone. The inscription is in three columns, with 145 lines of cuneiform writing, and so well has it been preserved that every one of the fifteen hundred or so of wedge groups is perfect.

The first part of the inscription is familiar because it is practically a duplicate of the records upon similar cylinders discovered elsewhere. Nebuchadnezzar begins in his boastful way by telling who and how great he is. Then follows an account of the building of the great walls of Babylon "mountain high," and of the restoration of several temples in Babylon and other Babylonian cities, including the Biblical cities of Ur, Larsa, and Erech, and of the tower at Borsippa, which travelers have called the tower of Babel. His account of how the gods instructed him to make a charm against disease, and to bury it in the foundation of the temple, hints at the superstition of his time. His prayer to the goddess Ninharrak shows his piety and command of beautiful language.

The last part of the inscription is of historical importance, for it is new. In it he speaks of restoring the temple at Marad, and ends with a prayer to Lugal-Marad, the local deity of the place. A translation of the inscription is as follows:

"I am Nebuchadnezzar, King of Babylon, the great, the mighty, the favorite of Marduk, the powerful prince, the beloved of Nabu, the ruler who knows not weariness, the protector of the temples Esagil and Ezida, who is obedient to Nabu and Marduk his lords, who does their bidding; the wise Lord, the darling and the joy of the heart of the great gods, the first-born son of Nabopolassar, King of Babylon.

"When Marduk, the great lord, made me the rightful son, to rule the land, to be the shepherd of his people, to care for the city, to rebuild the temples, he bestowed upon me his great power. Tremblingly I was obedient to Marduk, my lord. I completed Imgur-Bel and Nimitti-Bel, the great walls of Babylon, his mighty city, the city of his exalted power. At the entrance of the great gates I erected strong bulls of bronze, and terrible serpents standing upright. My father did that which no previous king had done. With mortar and bricks he built two moat walls about the city, and I with mortar and bricks built a third great moat wall, and joined it and united it closely with the moat walls of my father. I laid its foundations deep to the water level; I raised its top mountain high. I constructed a moat wall of burned brick about the west wall of Babylon. My father built the moat walls of the Arahtu canal securely with mortar and brick. He built well the quays along the opposite shore of the Euphrates, but he did not finish all his work. But I, his first born son, the beloved of his heart, built the moat walls of Arahtu with mortar and bricks, and joining them with the moat walls of my father, made them very solid.

"Esagil, the wonderful temple, the palace of heaven and earth, Ekua, the temple of Marduk, the lord of the gods, Ka-hili-sug, the dwelling place of Zarpanit, Ezida, the temple of the king of the gods of heaven and earth, I clothed with shining gold, and made bright like the day.

"Ezida, the favorite temple, beloved of Nabu, I restored in Borsippa. With gold and jewels I made it beautiful like paradise. I overlaid with gold its great beams of cedar, and arranged them by three to cover Emahtila, the shrine of Nabu. I rebuilt and made lofty Emach the temple of Ninharsag, in the center of Babylon. . . .

"I did a thing which no king before me had ever done. To the west of Babylon, at a great distance from the outer wall, I constructed an inclosing wall 4,000 cubits in length about the city. I dug its moat to the water level. I walled up its sides with mortar and burned bricks, and I united it securely with the moat wall of my father. Along its edge I built a great wall of mortar and burned bricks mountain high.

"I rebuilt Tabisupurshu, the wall of Borsippa. To strengthen it, I built the wall of its moat about the city with mortar and burned bricks. In Borsippa I rebuilt the temple to Tur-lil-en, the god who breaks the weapons of my foes. Ebarra, temple of Shamash in Sippar, Eanna, temple of Ishtar in Erech, Ebarra, temple of Shamash in Larsa, Egishshirgal, temple of Sin in Ur, the sacred temples of the great gods, I restored and completed.

"The support of Esagil and Ezida, the rebuilding of Babylon and Borsippa, which

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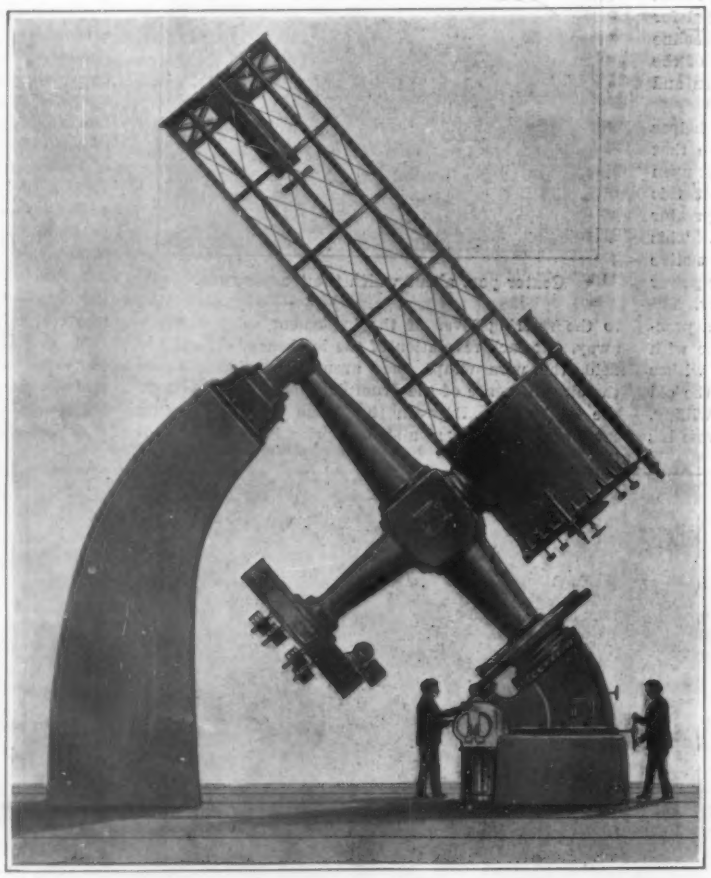


Powerful reflecting telescope of the Canadian government, 30 feet focal length.

The main purpose of the instrument will be the measurement of motion in the line of sight of stars fainter than the fifth magnitude.

Safe Moving Pictures

The Inventions of Nicholas Power

By Arthur J. Lang

Fig. 1.—A cheap moving picture theater, whose frequenters are dependent for their safety on the fire prevention devices which eliminate the hazard of the rapid-burning film.

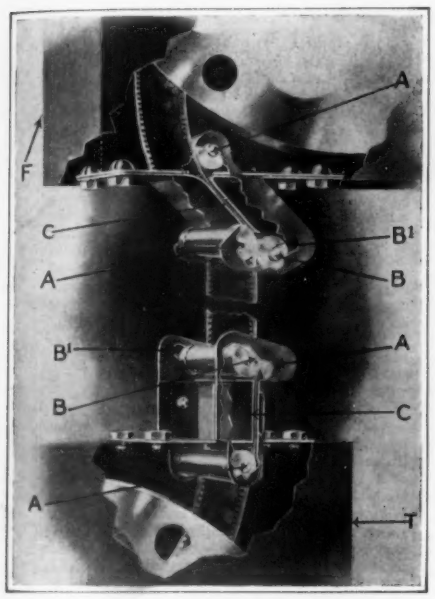


Fig. 3.—The film valve consists of a chute C and four rolls, A, A, B, B. A flame cannot pass the rolls, nor through the chutes to the film magazines.

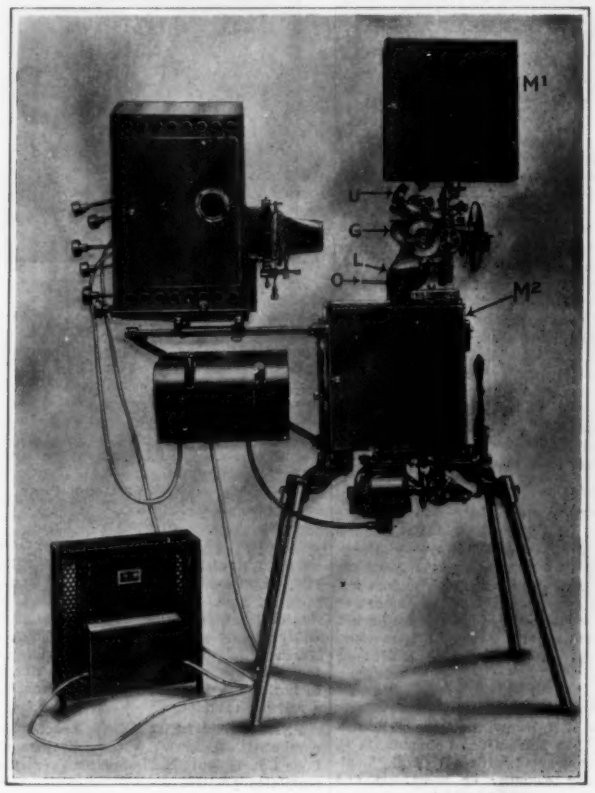


Fig. 4.—A characteristic type of improved electrically-driven motion picture machine in which fire hazards have been minimized and various projection faults (flicker, etc.) practically eliminated.

Fig. 2.—The operator of a moving picture machine takes his life in his hands in operating machines not equipped with adequate safety devices or in failing to properly maintain these devices in service when operating modern high-grade machines. The character of operators is a big factor in averting panics, always potential in film theater audiences, as modern conditions require highly intelligent operators.

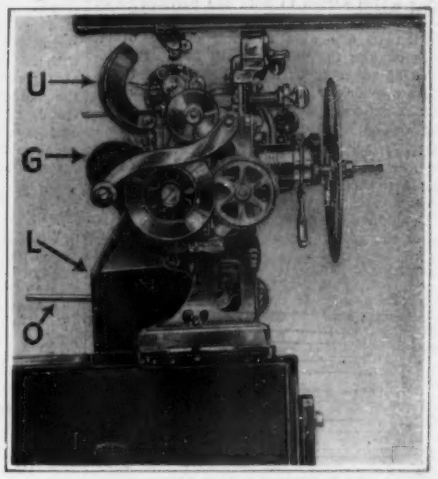


Fig. 5.—How the film is protected above and below the aperture by the shield U, the shield L, the guard plate G. Lever O used to pull loop.

EVERY day nearly ten million persons flock to the film theaters in the United States. The pictures that flicker before their eyes are photographic images imprinted in strips of film that if ignited burn with the explosive rapidity of smokeless powder. These strips of film move across a stream of concentrated light while pictures are being shown, light so powerful that the rays if focused on a surface of wood could bore into it with the speed of a flame. Were it not for its rapid movement the film would blaze up immediately if the light were not cut off.

Yet films ignite in projecting machines but rarely, if ever, in this country; at the worst, mere holes burned in the strip. A picture or two is cut out, and after the clipped ends are cemented together, the film is ready for another run.

But in other countries south of the United States and abroad, the results of film ignition in projecting machines have been far more serious. Recently fifty-eight children, sixteen women and one man were killed in a panic precipitated by the ignition of a film in a picture theater in Surabaya, Java. One hundred and thirty-one persons, chiefly children and women, were killed and injured, May 27th, 1912, in a film show in Villareal, Spain. The picture machine was not equipped with a take-up reel, and as films were run through the machine they were allowed to pile up on the floor. The film carrying the final pictures of the performance caught fire and ignited the heap of other films on the floor. Since then a number of other horrors of a similar character have occurred abroad, and in the Latin republics of Pan America. But the United States has been singularly free from catastrophes of this sort and magnitude during recent years. The chief reason is that more progress has been made here than in other countries in perfecting the safety features of projecting machines that minimize, or eliminate entirely, fire perils in films. Much of that progress is due to the inventive genius of Nicholas Power of New York.

A motion picture machine comprises two parts: A source of light (the lamp), and the mechanism for operating the film (the machine head). Manifestly safety lies in keeping the inflammable film away from every possible source of ignition, and so closely confined within the machine head, that if ignited by the rays of light, the film will not burn more than a few inches at the worst.

In the early machines films were anything but closely confined. In the "spool-bank" type used until 1898 the film passed over and under the lamp house to and from a box containing series of spools upon which it was threaded. At that time films were made only in lengths of seventy-five feet with ends jointed together, forming endless belts. Frequently the films would touch the lamp house and promptly ignite. After a number of such accidents the belts of film were laid in glass-covered wooden boxes mounted under the machine head.

When longer films began to be used they were wound on reels. A film to be shown was wound on a reel mounted on a bracket clamped to the top of a machine head. As the film was run through the machine, it was spilled on the floor under it. Not only did spilling the film add to the fire peril, but the film itself was scratched or broken and the pictures damaged. Even in New York city in the days when motion pictures "chased" vaudeville performances in large theaters, it was not an uncommon occurrence for films to fall over the rails of balconies, behind which projecting machines were located, into the crowded auditorium below.

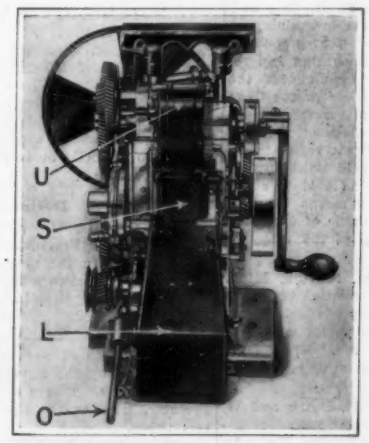


Fig. 6.—The shutter S automatically closes and cuts off the light when the machine stops.

To preserve the pictures some machines were fitted with bags hung so as to receive the films as they were run out. In some cases films were wound by hand on take-up reels instead of being spilled in bags.

In 1904 Nicholas Power devised a take-up or rewinding reel that would automatically vary its speed in proportion to the increasing diameter of the circle of film as it wound on the reel, the speed of the reel being greatest at the initial operation of winding and automatically decreasing as the film wound up, so that the tensional strain would be uniform throughout the winding.

Power's take-up device comprises a spindle, which carries the reel, and the driving pulley which is driven by a belt from the machine-head mechanism. The pulley is composed of two separate plates. One plate is made fast to the spindle driving the reel, the other rotates loosely on the spindle, but is held against the face of the driving plate by a spring coiled around the spindle. As the film winds on the reel and begins to pull, the spring on the spindle yields, allowing the driving belt to run on the loose pulley plate and slip in the driving side. Also the device is arranged to be driven by a chain or a gear.

While the take-up device improved the operation of a machine it did not lessen the fire hazard much, as the film was exposed on reels over and under the machine head. Immediately following the development of the take-up device, Power introduced metal magazines (M^1 and M^2) Fig. 4, to contain the feed and take-up reels; and to prevent the flames of burning films from entering the magazines, he devised a special form of valve, Fig. 3, which allows the free passage of film in or out of a magazine, but which effectively stops the progress of combustion in a blazing film.

The film valve (Fig. 3) consists of an elongated chute *C* and four rolls *AABB*. The upper valve shown in the figure is mounted in the inside lower corner of a feed reel magazine *F*, and the lower in the outside upper corner of a take-up reel magazine *T*. The rolls *A* are fixed guide rolls which keep the film from rubbing against the walls of the chutes. The rolls *B* are idler rolls whose journals bear in slots B^1 cut at angles so that no other force than gravity will be necessary to hold the rolls against the film, thus preventing tensional stresses. The rolls have outer flanges which press against the margins of the film, so that nothing touches the emulsion or picture surface. It is practically impossible for a film to burn past the idler rolls and their companion fixed rolls, but should that occur the blaze could not enter the chutes.

Machine magazines for film reels M^1 and M^2 (Fig. 4) are made of heavy Russia iron in square forms, without solder. The upper or feed reel magazine M^1 is mounted on a rigid spider which is attached to the machine head frame. The lower or take-up reel maga-

(Concluded on page 320.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

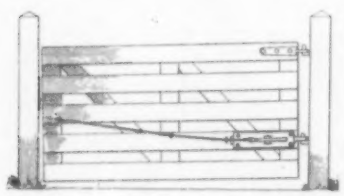
Pertaining to Apparel.

DRAW STRING.—BERTHA CLARK, 228 52nd St., Brooklyn, N. Y. The invention provides a draw string or band for use in the hem of the gathered waistband of a washable garment and arranged to allow of conveniently and quickly removing the draw string or band prior to washing the garment, and to permit the ready insertion of the draw string or band after the garment is washed.

Of Interest to Farmers.

REVOLVING HARROW.—J. M. BASSLER, Marion, Ohio. The improvements in this case are embodied in two circular harrows arranged horizontally and mounted on axes having bearings in draft bars whose front ends are loosely connected by a draft appliance, their rear ends being coupled elastically by a bowed plate spring which serves to hold the peripheries of the harrows in frictional contact, so that the rotation of one aids rotation of the other, which enables the harrow teeth to clear themselves of adhering turf, vines, or other trash. Means provide for nabling the harrows to conform more easily to inequalities of the surface over which they are dragged.

HINGE.—T. MITCHELL, Oquawka, Ill. This inventor provides an adjustable hinge to be used with fence gates, to compensate for settlement in the gate, or in the hinge post, or to be adjusted for holding the outer swinging end of the gate in raised position to clear any



HINGE FOR FARM FENCE GATES.

obstruction which may occur in the path of the gate. An object of the invention is to provide adjusting means for the hinge, which may be operated from the outer end of the gate, so that the leverage afforded by the length of the gate may be taken advantage of in raising the gate, while the adjusting means is operated.

Of General Interest.

RETAINING DEVICE.—A. Q. WALSH, 2 W. 47th St., Manhattan, N. Y., N. Y. This invention provides a device for holding fountain pens, pencils, rules, eyeglass cases, clinical thermometers, and similar articles securely in position in a pocket of a vest or other garment while the latter is worn, and arranged to prevent the article from accidentally falling out of the pocket on the wearer stooping or making other bodily motions.

BOTTLE HOLDER FOR CHLOROFORM INHALERS.—L. DROSIN, 1666 Lexington Ave., New York, N. Y. The invention comprises means for supporting a bottle of anesthetic in any suitable position upon the usual inhaler frame, and the bottle holding means providing for use in connection with any reasonable size or shape of bottle without special adjustment.

ADJUSTABLE FOOT REST.—F. A. CARR, 608 Petty St., McKeesport, Pa. This foot rest is arranged to permit of raising or lowering the foot board a desired distance above the floor, according to the size of the scholar

ADJUSTABLE FOOT REST FOR DESKS, ETC.

using the desk on which the foot rest is applied, and to allow of folding the foot rest and swinging the same into vertical position between the standards of the desk and below the table thereof when dispensing with the use of the foot rest or for other reasons.

WATER SKEE.—V. VOLLER, Bemidji, Minn. This invention is in the nature of a water skee, the object being to provide a strong, durable, and safe construction which may be readily propelled through the water and effectively guided in its course. The action is substantially similar to that of skees on the snow, and the knack of actuating the water skee is readily acquired.

TOOTH BRUSH.—C. E. CARROLL, Newport, Ark. As the formation of tartar begins underneath the gum margin below the necks of the teeth, adheres to the roots and remains as a permanent irritant to the gum, and as no brush in general use is effective in preventing such condition, the present invention has been devised to prevent the lodgment of foreign substances within the free margin of the gums.

Hardware and Tools.

LOCK.—W. MEIER, 1951 Seventh Ave., Manhattan, N. Y., N. Y. This invention comprises a removable bolt adapted to secure in position a hasp used for fastening a door or the like, a movable member having means for holding the bolt in place, and key-controllable means for actuating the movable member, the last named and the hasp being positioned at the same side of the door.

FOLDING STEP LADDER.—J. DYBECK, care of M. Stenabaugh, Box 464, Sault Ste. Marie, Mich. In the present invention the step section is pivotally suspended by a hanger at the top, the hanger constituting a plate spring, and a link connects the step section with the stand or frame below the hanger, the arrangement being such that in the swinging of the ladder to an inner position within the stand, the hanger is placed under tension so as to force the ladder downwardly and by its engagement therewith hold it securely within the stand.

Heating and Lighting.

VALVE FOR GAS BURNERS.—E. S. ALLEN, 517 W. 134th St., New York, N. Y. The purpose of the inventor is to provide a valve for gas burners arranged to permit convenient adjusting with a view to regulate the amount of gas passing from the service pipe to the burner and to be automatically closed by a movable member of a stove so that the gas is shut off from the burner.

Household Utilities.

BED PAN.—A. B. KNOWLTON, care of Knowlton Hospital, 1515 Marion St., Columbia, S. C. The pan is constructed with a central, longitudinal, primary chamber or receptacle and with an overflow receptacle which partly surrounds the primary one, and a third receptacle into which both the others finally discharge their contents. Such final receptacle is located at one end of the pan and holds the excreta safely when the pan is carried, in vertical position like a pail, by means of a handle located at the opposite end of the pan. The final receptacle is constructed with a flat head or end so that it may be supported in vertical position upon a floor or other flat surface.

Machines and Mechanical Devices.

CHRONOMETER ESCAPEMENT.—W. E. WALKER, Woodstock, Ohio. The purpose here is to provide a detached escapement in which the balance receives impulse direct from the teeth of the escape-wheel, without the use of guard pins, banking pins, or springs, and which will effectively perform its function in the face of hard or rough usage.

BOAT PROPELLING MECHANISM.—J. B. TRESCOTT, care of Wisco Supply Co., 7th and 8th Sts. and Clark Ave., St. Louis, Mo., and R. C. Busch, St. Louis, Mo. The invention provides motor units arranged for propelling boats; provides means for demounting and remounting units to augment or diminish the motive power for propelling boats or the like; provides a multi-unit prime mover for vessels, adapted for temporary installation; provides units for propelling shallow-draft vessels; provides means for harnessing said units to permit shifting thereof for use as aids in steering the vessel; and provides means for harnessing the units to change angle of operation thereof relatively to the keel of the vessel to which they are applied.

SCALE.—V. O. KLINGLER, Slayton, Minn. The principal object of the invention is to provide an improvement especially adapted for use with the scales, whereby the valves will operate more easily, the use of the improvements also tending to save the wear on certain of the co-operating parts.

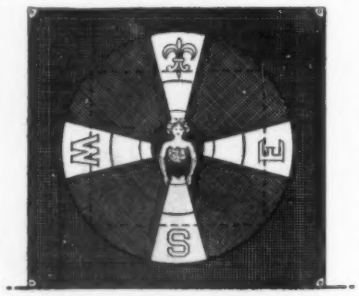
JIGGING MACHINE.—O. H. BOHM and W. M. MCCOY, Birmingham, Ala. Address the former, 725 Sergeant Ave., Joplin, Mo. An object of the invention is to provide a device in which the working parts of the plunger reciprocating mechanism are submerged in oil so as to provide a thorough and constant lubrication, which protects the lubricating oil against contamination by grit, water, or other foreign substance.

Prime Movers and Their Accessories.

ROTARY VALVE.—G. P. B. HOYT, 1 Clinton Place, Jamaica, N. Y., N. Y. In this case use is made of a cylindrical valve chamber having parts in its side and an opening in one end, a rotary valve fitting into said chamber and having a port adapted to register with said valve chamber ports, the said rotary valve being split at its port, and an annular partition fixed in the said valve chamber and having ports opposite the said valve chamber ports, the said partition being split intermediate its ports.

Pertaining to Recreation.

ILLUSORY THEATRICAL DEVICE FOR VAUDEVILLE ACTS.—H. J. MOORHOUSE, 336 W. 6th St., Superior, Wis. This invention relates to a stage appliance for use in a vaudeville act to produce an illusory or mystic effect, and it relates more particularly to a device adapted for use in connection with stereopti-



DEVICE FOR VAUDEVILLE ACTS.

con, motion or other pictures. The illusion differs from all other attempts, by reason of the transformation taking effect under full white light, without the use of mirrors; and in the area of the picture screen containing only about 50 per cent of picture holding material, or two square feet of picture for each square foot of screen. The illusion is intermixed with acting, music, songs, animated scioptic posing effects and a mysterious fading away of the living image and shield.

Railways and Their Accessories.

CHILD'S CRIB OR BERTH ATTACHMENT FOR RAILROAD CARS.—L. W. GEEREKEY, Douglas, Ariz. In the present patent the invention is an improvement over that disclosed in Mr. Geerekey's patent, No. 1,055,897, dated March 11th, 1913, and it has reference to an improvement in the means for securing a crib to horizontal rails applied to the inner side of a railway carriage.

PNEUMATIC DERAILER.—J. J. MCINTYRE, care of D. B. Stauft, care of Taylor Coal & Coke Co., Uniontown, Pa. This invention contemplates positive means for derailing either loaded or empty trains or parts of trains, or "trips" of cars or mine wagons when operating on incline planes or slopes, in order to prevent serious wrecks when cars become detached through accident or otherwise. The invention provides for promptly derailing a runaway car or cars before the same attain a destructive momentum.

AUTOMATIC TRAIN STOP.—J. S. ALLEN, 115 Broadway, New York, N. Y. The stop has a hollow post, in which a shaft is journaled, a cap being secured to the shaft, and having depending lugs, which engage stops on the post for limiting the movement of the cap and shaft. The cap extends outward from the shaft, with means for protecting stops and lugs from the weather. Secured to the cap is an extending arm engaged by a contact member, carried by arms secured to a shaft, journaled in a bearing on a locomotive or car with means that will rotate the shaft journaled in the bearing in the locomotive or car, to open the valve.

Pertaining to Vehicles.

WHEEL.—J. PIERCE, Ogden, Utah. Address J. G. Heywood, same place. This invention relates to wheels, and more particularly to resilient treads. An object is to construct a wheel in such a manner as to avoid the use of pneumatic tubes and casings, and yet produce a tread which will yield to an uneven surface so perfectly as to produce a pneumatic result.

Designs.

DESIGN FOR A RING OR SIMILAR ARTICLE.—W. FISCHER, 45 John St., New York, N. Y. In this gracefully rounded ring the setting comprises a number of prongs that clasp a high set disk, in the center of which the gem is placed.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12971) L. H. W. says: The original brightness can be restored to pearl articles by first cleaning them with pure olive oil. This penetrates the pearl object and does away with the blurred look. Then polish as one polishes a finger nail. Apply the polish and rub with a chamois skin.

(12972) L. H. W. Writes: Paint may be removed by the following mixture: One pound of commercial potassium hydroxide is dissolved in 40 ounces of acetone. Then add 20 ounces of methylated spirit, 20 ounces of oil of turpentine, 20 ounces of spirit of petroleum, and 10 ounces of castor oil. Wash off the paint with this mixture, using old rags to prevent mussing. If the paint is thick, a dull knife will aid materially in removing it, while no harm will be done to the wood if care if exercised.

(12973) H. J. G. asks: Will you be kind enough to tell me whether there are any detrimental effects incurred by the moving-picture operator, and if any, how caused? A. We know no reason why a moving-picture operator should be injured by his occupation more than any other man who works about electric lights. The eyes should not be exposed to the arc light directly at all, or certainly not for any length of time.

(12974) S. T. T. asks: In an argument recently with a railroad locomotive engineer, he declared that the top surface on the drive-wheels of an engine travels faster than the lower part of the wheels, but could not explain the fact. If this is so, will you kindly send me an explanation? It seems a physical impossibility to me; however, it may be true. A. With reference to the motion of the parts of a wheel of a locomotive on the track, it must be evident to you upon thinking of it that the part of the wheel which is in contact with the rail at any moment is not moving forward at all, unless it is sliding on the rail, which you know it does not usually do. The top of the wheel is moving forward very rapidly. The bottom of the wheel is at rest on the rail, and the top is moving forward. This your friend, the engineer, knew, but could not explain. It is not a physical impossibility, but a fact. The wheel must not slip on the rail if it is to draw the train. If it does not slip, it is of course at rest on the rail at the point where it comes in contact with the rail.

(12975) S. C. S. asks: Inclosed find 10 cents for which send me copy of SCIENTIFIC AMERICAN that has the article in it in regard to making experiments with the *violet ray by using violet-colored glass.* If you can tell me where I could find anything else regarding this, I would like to know where it is. A. We send you under separate enclosure our SUPPLEMENT No. 1920, containing a description of the various filters which have been used for separating the ultra-violet rays from the rest of the wave lengths of light. You can probably obtain the Wood ultra-violet ray filter directly from Prof. R. W. Wood, Johns Hopkins University, Baltimore, Md. We would advise that a violet-colored glass will not by itself quench all the rays except the ultra-violet. A blue glass should be used with the violet glass for good effects. The choice of tints is also important. It is better to get a glass made by a person of experience for first experiments. Then you will know that you are producing what you should produce. Besides the SUPPLEMENT named above we have published many papers on this very interesting subject. We name the following: SCIENTIFIC AMERICAN, Vol. 102, No. 12; Vol. 107, No. 13; Vol. 109, No. 3; and SUPPLEMENT Nos. 1711, 1762, 1778, 1787, 1807, 1809, 1831, 1845, 1856, 1895, 1953, price, ten cents each.

(12976) D. L. W. asks: 1. I have read that water at 39 deg. Fahr. is heavier than at any other temperature. Will you kindly explain why? A. Water is densest at about 39 deg. Fahr. and expands if either heated or cooled from that point. We do not know the reason why this is so, but it is of the greatest importance in nature. Because of this, ice forms on the sur ace of water instead of forming at the bottom of lakes and rivers and oceans. 2. I have a toadstool which is petrified. Now that it has turned to stone, it is several times heavier than before. Will you kindly tell me where it got the additional weight? A. Your petrified toadstool weighs more than before petrifying because stone is heavier than the vegetable matter which was there formerly. 3. I have noticed more meteors fall to the southward than any other direction. Is there any reason for this? A. We know no reason why you should have seen more meteors fall toward the south than toward any other point of the compass. Meteors enter the air from all directions and travel through it. 4. Will you kindly tell me if extremely cold weather will destroy the caterpillars in the brown-tail moth nests? A. The brown-tailed moth seems to get through the winters in the North in good numbers, so you might infer that it can endure the cold of our winter seasons.

NEW BOOKS, ETC.

A DAY IN THE MOON. By the Abbé Ch. Moreux. London: Hutchinson & Co., 1913.

The Abbé Moreux, whose contributions on astronomy have appeared in many of the better popular French magazines, has presented in this book a very readable account of the moon. To be sure, his day in the moon means not a twenty-four-hour terrestrial day, but fifteen terrestrial days, in other words, a lunar day. By carrying the reader in imagination to the moon, by exhibiting to him the great craters, mountain ranges, and vast expanses of frozen lava, the Abbé presents his facts in a very vivid way. The book is admirably illustrated. The translation may be commended as a good piece of work.

HANDBUCH FÜR HEER UND FLOTTE. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten, Generalleutnant z. D., fortgeführt von Hans von Albert, Hauptmann a. D. Unter Mitwirkung von etwa 400 der bedeutendsten Fachautoritäten. Preis jeder Lieferung 2 M. —2,40 K. Berlin W 57: Deutsches Verlagshaus Bong & Co.

The 65th, 66th, 67th and 68th installments of the "Handbuch für Heer und Flotte" take up from Kapudan-Pascha to Krassnoje Sselo. The more important articles are those on *Karte, Kasematte, Kavallerie, Königgrätz, Kosten und Volkswirtschaftliche Wirkungen der Kriege*, and *Konstantinople*. Major-General von Werlhof has written an excellent article on *Kasaken* (Cossacks) which bears the marks of much original research.

THE WANDERINGS OF ANIMALS. By Hans Gadow, F.R.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

After tracing the rapid growth of this young science, the author shows how important is the subject of geographical distribution. The home is sketched, particularly the homes offered by tropical forests, deserts and high mountains, so that the various effects of climate and interdependence of animal and plant life may be brought out. Short chapters on the modes, means and rates of spreading show the effect of the natural increase in numbers, the relation of species numbers to individual numbers. How the map of the world has undergone many vast changes, and thus caused animals to readjust their home requirements, is simply indicated. Especial portions of the book deal with the distribution of a considerable number of various groups of animals, mostly terrestrial vertebrates, selected for their fitness as test cases.

THE ATMOSPHERE. By A. J. Berry, M.A., Lecturer in Chemistry at Downing College. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Meteorology plays no part in this book. Only chemical and physical phenomena are considered. Hence the book discusses the history of atmospheric study, gives a very good account of the principal constituents of the atmosphere. Briefly it reviews modern views on combustion and similar problems. The chapter on the escape of gases from planetary atmospheres according to the kinetic theory is particularly well done.

PRIMITIVE ANIMALS. By Geoffrey Smith, M.A., Fellow of New College, Oxford. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This little book well fulfills its object of presenting a simple account of modern views on the relationships of the chief groups of the animal kingdom, the principal grounds on which the modern classification of these groups may be justified, and an outline of the evidence by which some of the main streams of animal evolution can be traced.

ROCKS AND THEIR ORIGINS. By Grenville A. J. Cole, Professor of Geology in the Royal College of Science for Ireland. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This book is to be regarded as a companion to Mr. E. A. N. Arber's "Natural History of Coal," also forming one of the Cambridge manuals of science and literature; for the author has omitted very wisely a discussion of those subjects which Mr. Arber had to take up. Hence the author has not taken up the carbonaceous rocks, but he does give a very readable account of rocks in general, limestones, sandstones, clays, slates, igneous rocks and metamorphic rocks.

THE NATURAL HISTORY OF COAL. By E. A. Newell Arber, M.A. Cambridge: The University Press. New York: G. P. Putnam's Sons.

A more difficult subject than the geology or the palæobotany of coal could hardly be selected for popular discussion. Although coal is one of the most important substances in the world, still science has not yet determined what is the true origin of the material, how it was formed, etc. Hence the book before us is confined very largely to an elucidation of past and present theories.

YOUNG FOLK'S HANDBOOK. Philadelphia: American Institute of Child Life. 8vo.; 215 pp.; illustrated.

The After School Club represents an organized effort to guide boys and girls into happier and more educative and efficient ways of work and play. Its headquarters are at Philadelphia, but its scope is national, and it takes in young people of all ages. The members are graded, according to age, into "inner circles," each with its own particular interests and activities. The "Young Folk's Handbook" tells all about the club—what it is, what it is doing, how it does it, and why. The progressive sections of the book correspond with the ages dealt with—up to six years, from seven to fourteen years, and from fourteen to twenty-one years. Instruction is given in the exercise of the muscles, the development of regular habits, and the development of the imagination and the powers of expression. A large part of the work is devoted to a bibliography of suitable books, briefly reviewed. Parents and teachers will find both book and organization of immense value, and would do well to make them factors in the lives of their charges.

THE MODERN LOCOMOTIVE. By C. Edgar Allen. Cambridge: The University Press, 1912.

The author has handled a very difficult subject with all the simplicity that can be expected. The general principles governing the design and working of a modern locomotive are clearly presented, and the broad lines of development from its comparatively simple predecessor of twenty-five or thirty years ago boldly traced. The thermodynamics of the locomotive engine play a very important part in the book, which is as it should be.

AERIAL LOCOMOTION. By E. H. Harper, M.A., and Allen Ferguson, B.Fc. With an Introduction by G. H. Bryan, Sc.D., F.R.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Although since this book was written aerodynamic discoveries have been made, notably by Eiffel, which have markedly influenced aeroplane design, nevertheless the work may be recommended as a clearly worded account of the principles underlying the construction and behavior of aeroplanes and dirigibles.

THE PHYSICAL BASIS OF MUSIC. By Alexander Wood, M.A., D.Fc. Cambridge: The University Press. New York: G. P. Putnam's Sons, 1913.

An excellent, simply-worded presentation of modern theories of sound. In the space of only one hundred and sixty pages the author has managed to compress all that a well-educated man ought to know of sound and music.

LIFE IN THE SEA. By James Johnstone. Cambridge: The University Press. New York: G. P. Putnam's Sons.

Mr. Johnstone has written this popularly worded book on the basis of the German and Scandinavian studies of microscopic life contained in the sea. The German investigation, it will be remembered, was intended to determine the quantity of plankton; the object of the Scandinavian hydrographers was to forecast seasonal changes in the climatic conditions of their countries by studying the currents of the sea. The researches conducted by these Germans and Scandinavians have had a marked influence upon marine biology and that influence is reflected in this book.

HOUSE FLIES AND HOW THEY SPREAD DISEASE. By C. P. G. Hewitt, D.Sc., Dominion Entomologist, Ottawa, Canada. Cambridge: The University Press. New York: G. P. Putnam's Sons.

This little volume will undoubtedly fulfill the hope of its author that it will not only bring home to a greater number of people the true nature of the house fly, but also indicate the means to be taken to eradicate it or render it no longer a menace. The author has done much work in investigating the structure, development and biology of the house fly and therefore writes from first-hand knowledge.

HOW TO BUILD UP FURNACE EFFICIENCY. A Hand-book of Fuel Economy. By Jos. W. Hays. Chicago: Jos. W. Hays. 12mo.; 126 pp.; illustrated. Price, $1.

The writer compels attention from the start; tells you exactly why and how your fuel is being wasted, how to locate the point of waste, and how to stop it and keep it stopped. He is insistent that a full quarter of your coal is being needlessly wasted in burning, and engages to save you a quarter of your coal pile. Starting with the proposition that the most efficient furnace is the one which completely consumes the combustible with the least surplus of air, he shows how to diagnose trouble by the aid of the tallow candle, the flue gas analyzer, the differential draft gage, and the pyrometer. His treatment is always popular, often humorous, sometimes whimsical, but it has the true stuff at the core of it, and it presents advice worth following and knowledge worth assimilating.

THE RECENT EVOLUTION IN ORGAN BUILDING. Being an Account of Modern Developments. By George Laing Miller. New York: The Charles Francis Press, 1913. 12mo.; 192 pp.; illustrated. Price, $1 net.

The organ student will find in this work an illuminating presentation of organ history and of the men who have made that history. The papers are written primarily for the benefit of those who are concerned either in the purchase or the renovation of an organ, and specifications of many of the world's notable instruments are fully given. No organist should be without an understanding of the mechanical principles and the detailed construction of his instrument, and such knowledge is admirably supplied by the monograph in hand. The musical reputation of the author is international, and his qualifications for the task he has undertaken are indisputable.

MOTION PICTURE MAKING AND EXHIBITING. By John B. Rathbun. Chicago: Charles C. Thompson Company, 1914. 12mo.; 236 pp.; illustrated. Price, $1.

The field of the motion picture is steadily enlarging. From a mere amusement device it is coming to be utilized as a strong educational factor, and in other ways is demanding increasing respect and consideration. Mr. Rathbun's volume, while not so bulky as some similar works on the market, is clear and comprehensive, and demonstrates the author's fitness for the task of imparting his own wide knowledge. Early efforts in motography are reviewed, the modern projector and its accessories are described, and the film is shown in successive steps of its historical development. The actual picture taking is, of course, the subject of several lengthy sections, and the intimate details of studio arrangement and practice are revealed. The writer clearly explains the way in which certain trick films are produced. A portion of the work is also given over to the writing and marketing of scenarios. That section of the volume dealing with the exhibition end of the business is quite as lucid and thorough as the chapters preceding, and contains instruction and suggestion that no theater manager can afford to ignore.

THE PRINCIPLES OF THE APPLICATION OF POWER TO ROAD TRANSPORT. By H. E. Wimperis, M.A., M.I.E.E. New York: D. Van Nostrand Company, 1913. 12mo.; 130 pp.; illustrated. Price, $1.50 net.

The ever-increasing importance assumed by road transport carries with it a complication of problems toward which investigation and experiment are constantly leading to higher efficiency, both in the road itself and in the vehicle. Any consideration of resistance to motion on a road must deal with the primary factors of road-and-wheel friction, with the loss of power inherent in the mechanism, and with the air resistance. These factors are very thoroughly canvassed by the writer, and the most approved methods of determining their extent and of mitigating their drawbacks are explained. Their laws are reduced whenever possible to tables and formulæ. Bench and road tests are described and the instruments and devices used are made the subject of illustration. Tractive resistance and friction curves are presented diagrammatically; the result of American experiments are tabulated and discussed; electric, internal combustion and hydraulic systems are subjected to investigation and analysis; and there are several useful appendices including reports on brake horsepower tests at Brooklands, road test report forms, etc. The work is a distinct addition to the somewhat scant literature of its subject.

L'ART DE RECONNAITRE LES FRAUDES. By M. Emile-Bayard (Inspecteur au Ministère des Beaux-Arts). Official of the Department of Beaux-Arts. Paris: Roger & Chernowitz. (99 Bd. Raspail.) In-18. 326 pp.; illustrated. Price, 5 francs; bound, 6 francs.

Owing to the experience which the writer has acquired by his long connection with the State Beaux-Arts department, he is well qualified to treat such subjects as the present, and the result is an interesting volume about the various kinds of frauds which are now so largely practised in the production and sale of works of art, antiquities and bric-à-brac. He points out the fact that the public is largely responsible for this state of affairs owing to the heavy demand for all kinds of antiquities that is made at present, and this is surely on the increase, so that antiquity itself would not have had the time to produce them. As a natural result, skill in producing "ancient" objects is increasing to keep pace with the demand, and the already great quantity of objects turned out is not likely to diminish. Paris is, of course, one of the centers of the industry. M. Emile-Bayard passes in review the classes such as painting, sculpture, old furniture, metal and ivory objects, ceramics and tissues, so that amateurs will be aided in detecting at least certain kinds of frauds, though in higher class work the skill in imitating antique objects often baffles even the expert. The author has chosen to enliven the book by the use of a literary style which we should have preferred to take for granted, and a condensation of the same would have allowed of devoting more of the work to positive data or at least of anecdotes and local color. Numerous photographs, over a hundred in fact, add much to the value of the book, and it is certainly a welcome contribution to this little-known subject.

COL. J. M. SCHOONMAKER AND THE PITTSBURGH & LAKE ERIE RAILROAD. A Study of Personality and Ideals. By Harrington Emerson. New York: The Engineering Magazine Company, 1913.

As Mr. Emerson developed and applied the principles of efficiency engineering—a profession at the head of which he now stands—the importance of the human element grew upon him. He realizes, now, as perhaps very few efficiency engineers do, that while machines may be arranged most effectively, while they may be supplied with material rapidly, while factory buildings themselves may be models in their way, ultimately the man behind the machine must be regarded as the hub of every great manufacturing enterprise. Curiously enough, everything in a modern industrial organization seems to have been closely studied except the human beings upon which its ultimate success is dependent. Hours, days, weeks, and even months may be devoted to a painstaking study of mechanical equipment, but not ten minutes to the men who will be charged with the operation and maintenance of that equipment. Mr. Emerson was one of the first to insist upon the same care in the selection of human as of mechanical material. His later writings have dwelt eloquently upon the necessity of studying a man's aptitudes before entrusting him with work, however important or unimportant. He has set up certain human standards and ideals which correspond with the standards and ideals to be followed in selecting and arranging the machines of a factory. Human characteristics mean as much to him as heat units to a mechanical engineer.

In this remarkable study of Col. J. M. Schoonmaker, to whom the amazing success of the Pittsburgh & Lake Erie Railroad is due, Mr. Emerson has crystallized his vast experience with humanity, and applied his human standards to a great personality. In many ways, the study of Col. J. M. Schoonmaker as a man, as a soldier and as an executive, is the most eloquent piece of writing that Mr. Emerson has thus far given to the public, which is saying much when it is remembered that Mr. Emerson has a highly developed literary sense, that he writes with a grace that comes from wide and appreciative reading, and that he drives home an argument with many a striking historical simile. In the first half of this book there are more quotable passages than are to be found in a whole volume of most modern essays. This study of Col. J. M. Schoonmaker as a personality and as an executive might be read with profit by every manager great or small. It is inspiring as well as instructive.

PLANT-LIFE ON LAND, CONSIDERED IN SOME OF ITS BIOLOGICAL ASPECTS. By F. O. Bower, Regius Professor of Botany in the University of Glasgow. Cambridge: The University Press. New York: G. P. Putnam's Sons.

"Few pursuits are more thoroughly misunderstood by the average person of education than that of the present-day botanist. . . . Old, time-worn aspects of the science are assumed still to be living problems of the day. In no point does this emerge more clearly than in the undue importance attributed to the finding and recording of new species and varieties. This is a survival of the time when the science, still in its infancy, was mainly engaged in the recognition and tabulation of living forms." Thus Prof. Bower opens his interesting, popularly written book, and prepares the reader for the modern view of botany. When the reader who clings to the old-fashioned view has finished this book, he will probably discard the notion that modern botany consists entirely in finding and recording new species and varieties and that a botanist's ability is to be measured by the number of the new determinations. He learns that the modern botanist concerns himself not simply with plants as they are, but inquires into their origin, their stability as species, and their relations with one another.

NUMBERS IN HISTORY. How the Greeks defeated the Persians, the Romans conquered the World, the Teutons overthrew the Norman Empire, and William the Norman took possession of England. Two lectures delivered before the University of London on October 6th and 7th, 1913, by Dr. Hans Delbrueck, Professor of History of the University of Berlin. London: University of London Press. Published for the University of London Press, Ltd., by Hodder & Stoughton, 1913.

The critical study of the four great campaigns which form the subjects of these lectures serve to overthrow some deep-rooted ideas. The "hosts" of old were anything but hosts as we conceive the term. What is more, the great captains of the past seem to have lied about their commands as glibly as tradition itself. Instead of overcoming 80,000 Austrians and Sardinians with a handful of 30,000 French, as he claimed, Napoleon was able to oppose 40,000 against 47,000.

The mere difficulty of handling large armies—a difficulty which could hardly be overcome before the days of the railroad—speaks eloquently against such vast bodies as the ancients sometimes claim to have hurled against their enemies. Even with the aid of nine railways and good roads, Von Moltke found it hard to move 400,000 men. Indeed, at Vionville, he could only use two of his ten army corps. Again, the mere task of provisioning an army of 100,000 or 200,000 is in itself something that the ancients could hardly have coped with. No wonder that Prof. Delbrueck doubts that Attila led 700,000 men from Germany over the Rhine into France, and no wonder that he doubts Herodotus's statement that Xerxes marched westward at the head of 5,100,000; for at that rate, the last man would have just about left Susa when the first arrived before Thermopylæ. Dr. Delbrueck even goes so far as to maintain that the Persians were outnumbered by the Greeks. "Why should the Greeks have more credibility? Are we to believe them only because we have no Persian author who contradicts their stories?" So, too, he questions whether Charles the Bold was able to oppose 100,000 men against the Swiss, and even goes so far as to maintain that the Burgundians were outnumbered by the Swiss. The invasion of the 200,000 Cimbri of the Roman histories becomes an invasion of no more than 40,000 people, of whom 10,000 were soldiers. Why? Because only that number could have migrated at once across the Alps. So the army of William the Conqueror is reduced from 60,000 to 7,000, and that of Harold to 4,000.

Protection from X-rays in Radiography

(Concluded from page 310.)

volume. In certain types of tube, therefore, the platinum anticathode gets red-hot at times, a circumstance which does not cause serious inconvenience with such low current volumes.

When, however, it is desired to employ higher energies in X-ray tubes, this elevation of temperature becomes the source of great annoyance in the operation of the tube and renders its construction very difficult. Here are the reasons: the center of emission of the X-rays is situated in the interior of a closed space in which the most careful vacuum has been made. This reduces very materially thermic radiation, so that, while the output of energy constantly raises the temperature of the anticathode there is but little tendency to heat-loss.

We must also take into consideration the fact that, at the Cochin Hospital, as in nearly all large installations, X-ray tubes are used with a capacity for current equivalent to 4 or 5 electrical horse-power. This energy is almost entirely concentrated in the cathode stream and, consequently, absorbed by the anticathode which reaches a white-hot temperature instantaneously. In order to avoid, as much as possible, this inconvenience, the anticathode is reinforced and constructed of the most refractory metals such as platinum, iridium, and tungsten.

It is also found likewise advantageous, especially when the exposure is to last several seconds, to employ accessory cooling, produced either by a volume of water stored behind the anticathode or by the passage of an air jet of high velocity (Barret-Jaiffe system), which removes with it a great quantity of calories.

Finally, in conjunction with the radiologic installation just described, we find, in this new clinic of the Cochin Hospital, apparatus for the use of high frequency currents,* a remarkably well equipped laboratory in the basement, and a collection of more than 25,000 radiographic negatives of considerable documentary interest.

Vocational Guidance and Efficiency

(Concluded from page 312.)

and economic—of these children; it shows itself also in the lives of the children that it manages to retain, for the majority of these are *not* going to be professional workers, and the school neither prepares them for anything else nor lets them even know that there is anything else. Vocational guidance will necessitate an organization and an administration of schools that will make it possible for the children's native abilities to assert themselves and to record themselves, that they may be utilized in planning each individual's school career in accordance with his particular needs, and not in accordance with a remote and arbitrary standard set up a few generations back by men interested in the evolution of grammatical inflection or Roman table manners.

Modern psychology, resting upon a biological foundation, has shown us the facts of individual variation in a new light. Plato recognized that all men were not equal, and he assigned the various functions in his Republic to classes of people manifesting special traits of character. The assumption of most philosophers who have thought about the distribution of human services in accordance with native talents has been that each person is naturally fitted to some particular place in the social and economic fabric; they have accordingly sought some scheme for discovering the earmarks of the scavenger and of the soldier. The newer studies of human nature show us that there are indeed individuals who are "natural born" poets or painters or hostlers or fishermen; but that the tremendous majority of boys and girls can be roughly divided into a few large groups, and that within each group by far the largest number of individuals are capable of adjusting themselves to a great variety of occupations. We can distinguish roughly between those who have a high degree of mathematical ability, those who have a low degree of it, and those who have a medium capacity for quantitative thinking. But we cannot direct all in the first group into astronomy or molecular physics; nor can we direct all in the last group away from engineering. We may say to a boy who is color-blind that he cannot become a locomotive engineer or a pilot or a sign painter, but color-blindness did not prevent Dalton from becoming a tolerably good chemist.

When it comes to discovering a child endowed with some talents in a high degree, or to encouraging a genius, we do not need "vocational guidance." We need some machinery for discovering mediocre talents in every-day girls and boys, some opportunity for developing these talents, some way of connecting them up with the useful work that is going on around us—that need it is that seeks to express itself through the vocational guidance movement. That the meeting of this need will help industry and commerce should bring the far-sighted business man to the assistance of the movement. That the meeting of this need will help put life and enthusiasm into the schools should bring all educators to its assistance. That the increased efficiency resulting from organized common sense applied to the direction of girls and boys will be both civic and economic, ought to interest the statesman.

* High frequency currents are used in the treatment of arterio-sclerosis, alleviation of rheumatoid and neuritic pains, the treatment of neurasthenic conditions and the like.—EDITOR.

Nebuchadnezzar as a Builder

(Concluded from page 314.)

I caused to be more magnificent than before, I did as I was instructed. All my noble deeds for the maintenance of the sacred temples of the great gods, which I did better than the kings, my fathers, I wrote upon a tablet of stone, and fixed for distant days.

"May the wise men after me read of all my works which I have written upon a tablet. May they comprehend the glory of the gods. I accomplished the building of the cities of the gods and goddesses, as Marduk the great lord bade me, and urged my heart to undertake.

"In those days, for Ninharrak, my beloved mistress, who guards my life and gives me good dreams, I dug up and found the ancient foundation of Eharsagil, her temple in Babylon, which fell to ruins in ancient days, and no previous ruler had restored. . . . But the temple was not suitable for the abode of Ninharrak. To strengthen the walls of that temple, and of mortar and bricks to make a temple worthy of Ninharrak, I sought earnestly. Upon the day when I asked the gods to reveal to me the future, Ramman and Shamask decreed that I make three burned bricks of sixteen fingerbreadths in size, and to make an image of burned clay as a charm against disease. And so I made three burned bricks of sixteen fingerbreadths and an image of baked clay to drive away disease, and I placed it in the foundation. With mortar and burned bricks I erected the main temple mountain high.

"O Ninharrak, majestic mistress, when with joy thou enterest Eharsagil, the house of thy pleasure, may words in my favor be ever upon thy lips. Make long my days and establish my years, may long life and an abundance of offspring be decreed by thy lips. Give peace to my soul; make my body strong, and make my visions clear. With Marduk, the lord of heaven, command the destruction of my foes, and the ruin of the land of my enemies.

"In those days, in the temple of Lugal-Marada, my lord, in Marada, whose ancient foundation no former king had seen since the days of old, I sought its ancient foundation and found it, and upon the foundation of Naram-Sin, the king, my ancient ancestor, I fixed its foundation. I made an inscription with my name, and placed it there.

"O Lugal-Marad, lord of all, hero, kindly look with favor upon the work of my hands. Grant as a gift a life of many days, an abundance of posterity, security to the throne, and a long reign. Smite

the evil minded; break their weapons; devastate the lands of my enemies. Slay all of them. May thy fearful weapons which spare not the foe be stretched forth, and be sharp for the defeat of my enemies. May they be at my side. Before Marduk, lord of heaven and earth, make my deeds appear acceptable; intercede for me."

How the Moving Picture Machine Was Made Safe

(*Concluded from page 315.*)

zine is set in a recess in the main frame of the picture machine. The magazine doors are of full size and hinged to swing open. Spring hinges are used so that the doors will not stand open.

The film is most likely to ignite in the machine mechanism between the upper and lower magazines. There, too, is the projection aperture where the light rays are condensed upon the film. Immediately following the development of the flame-proof film magazine, Mr. Power devised an automatic shutter to cover the aperture and cut off the light when the machine stopped.

The improved form of fire shutter for projection apertures *S* (Fig. 6) is controlled by the speed of the film. It does not open until the film attains a certain speed and closes when the film slows down and before motion actually ceases. The operating mechanism consists of a centrifugal clutch and lifting lever. The clutch revolves when the film moves, and when proper exhibiting speed is attained it operates and moves the lever, which raises the fire shutter, so that the light rays are free to enter the aperture. The shutter is hinged laterally and drops by gravity into a normal closed position.

That portion of the machine-head mechanism of a motion-picture projecting machine which holds the film flat as it is rapidly jerked over the aperture by the intermittent motion is termed a "film trap" or "gate." One of the first things Nicholas Power did was to construct film gates so that films would not burn beyond them when ignited in the aperture. And so snug do these fit that even the sprocket hole margins of films are not burned when films ignite.

As the metal surrounding the aperture is heated to a high degree by the condensed light from the lamp and likely to ignite slivers of film which sometimes cling to the parts, Mr. Power set out to minimize the possibility of these slivers igniting and firing the film by arranging a "cooling plate" over the film gate. This plate is set away from the gate about one quarter of an inch and absorbs and radiates the heat from the light. On this plate the fire shutter *S* (Fig. 6) is mounted.

Having protected the film at the most hazardous point, Mr. Power anticipated the necessity for protecting the film above and below the aperture. The first step was a flame shield of metal above the aperture to protect the film from fire below. The original form has been improved. In recent machines the upper shield *U* (Figs. 6 and 5) is a semi-circular trough of sheet metal, hinged at the bottom, through which the upper loop of film travels.

Next followed a shield below the aperture. This shield was improved from time to time until it formed a complete enclosure about the loop of film below the aperture *L* (Figs. 6 and 5). This form of lower film shield shown in these figures swings open at the side. Attached to it is a guard plate *G* (Fig. 5), which arrests the rays of light from the lamp when the shield is thrown open and guards the film from accidental ignition should the operator be careless in handling the films.

Having minimized the possibilities of accidental ignition of the film, Mr. Power turned his attention to improvements in the operating mechanism of the film. One of the most important of these is the automatic loop setter which prevents the loss of the necessary loop in the film between the aperture and the take-up reel. As the film travels past the aperture in rapidly successive jerks a direct pull from the take-up reel would break it. When a film

INQUIRIES

Inquiry No. 9364. Wanted the name and address of buyer of mica in a crude state.

Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic centering machine.

Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 3970. Wanted the names and addressess of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

breaks this way it continues to feed down from above, and oftentimes ignites in the aperture before the operator can stop the machine. The loss of this lower loop has been a common fault. It is caused in a number of ways—defective sprocket holes in the film, too much tension in the take-up, and the like. But no matter what the cause is, and even when highly mutilated films are run through the machine, the setter automatically adjusts the loop without let or hindrance on the part of the operator, every time it slips. Should the operator desire to set a fresh loop the lever *O* (Figs. 6 and 5) is depressed.

It is not generally understood that each picture on the film must stop over the aperture, but only for a minute fraction of a second. This is the foundation principle of kinematography. The mechanism that controls the stopping and starting of the film, the intermittent movement, must move the film during the period of travel as quickly as possible and allow the longest possible periods of rest, and do this without straining the film. Some years ago Mr. Power realized that the common star-wheel and geneva intermittent movement was not susceptible of further development and forthwith developed the cam and cross intermittent movement. This movement is one of Mr. Power's most signal inventions. It moves the film faster than the star and geneva possibly can, and increases the period of rest. And these operations are accomplished with far less strains and whip-lash pulls so common in the other movements. The film is not jerked from rest and does not attain full speed until the middle of the period of travel. This movement is one of Mr. Power's safety features, as it handles weak and poorly patched films without rupturing them, and every film that breaks means a potential fire. Moreover, this movement has eliminated the painful flicker so common in old mechanisms and increased the safety to the eyes of the public.

For these inventions Nicholas Power was awarded a gold medal at the International Exposition of Safety, which was held under the auspices of the American Museum of Safety in New York, December, 1913.

Popular Beliefs and Scientific Facts

POPULAR beliefs on scientific subjects apparently run in waves. Many of our readers remember the interest in hypnotism which followed the publication of "Trilby." Svengali with his "hypnotic eye" at once became a real and possible personage in the public imagination. The newspapers were full of stories of girls and women who had suddenly been fixed and paralyzed by the hypnotic gaze of some mysterious stranger with piercing black eyes, and who had been compelled by his will to fantastic acts which they were powerless to prevent. Fiction writers took up the idea, and stories centering around hypnotic influence became common. It was used as a plea in criminal cases, various culprits alleging that they had been hypnotized and compelled against their will to perform unlawful acts. All this occurred in spite of the fact, frequently stated and known by every scientific man, that the limitations of hypnotism are definite and well recognized, that no person can be hypnotized unknowingly or against his will, and that few persons are so susceptible as to be capable of being compelled to perform acts beyond their own volition and knowledge.

Another popular fiction which later on took the place of hypnotism was that of instantaneous anesthesia. Stories appeared in the newspapers of women who had been accosted by strangers and, under some pretext, had permitted a cloth or a handkerchief to be pressed momentarily over their mouth and nose. Immediate unconsciousness was said to have followed, resulting in a period of insensibility and irresponsibility, varying from a few minutes to hours or even days. Chloroform sprayed into an open window by means of an atomizer, anesthetics tied to a rag on the end of a pole and thrown into a bedroom, instant unconsciousness following the administration of drugs unknown

to physicians and pharmacists, were some of the variations of this idea. In the minds of physicians and nurses who see every day the administration of anesthetics, such stories only excite mirth. Any one who knows the difficulty and labor of securing unconsciousness through the use of anesthetics, even under the most favorable conditions and with every possible means for restraining and controlling the patient, knows how absurd such stories are.—*Journal of the American Medical Association.*

A Rockefeller Fund for the Study of Animal Disease

IT is announced that John D. Rockefeller, through the General Education Board, has added $1,000,000 to the endowment fund of the Rockefeller Institute for Medical Research, for the establishment of a department for the study of animal diseases, and that James J. Hill had given $50,000 to be devoted to the study of the disease known as hog cholera.

The ravages of diseases among animals have not only endangered the health of human beings, but have cost the country many millions of dollars. They are one of the factors in keeping up the "high cost of living."

In the history of medical science the work of Pasteur on anthrax and the more recent observations in this country on Texas fever in cattle, which opened the door to present knowledge concerning insect carriers of malaria, yellow fever and other diseases, are conspicuous illustrations of the value of studies on animal diseases.

How imporant the work promises to be would follow from statistics issued by the Rockefeller Institute. It has been estimated that in the Northwest alone hog cholera has killed $60,000,000 worth of swine during the last year.

Significant evidence of the importance of such investigations as the new department will undertake and of the expediency of undertaking them in the manner proposed is to be found in the fact that a contribution of $50,000 to aid in the study of hog cholera has been received from James J. Hill.

With the present facilities at hand, the income from the $1,000,000 endowment will make it possible to carry on the work on a broad scope at once.

A Legislative Reference Bureau for Congress

THE latest annual report of the Librarian of Congress devotes much space to the proposal embodied in recent bills before Congress to establish a legislative reference bureau, the functions of which would be to collect data bearing on proposed legislation and furnish expert assistance in the drafting of bills. The utility of such a bureau, not only as a means of preventing downright blunders in legislation or serious defects and ambiguities in the language of bills, but also of facilitating the work of legislators, is obvious to everybody who has given the matter any attention, and has, moreover, been demonstrated by the experience of about twenty State legislatures which have already adopted a plan of this character. It is proposed to make the Congressional legislative bureau a branch of the Library of Congress.

Herschel Island Police Post Abandoned

IT is reported that this winter, for the first time in many years, the Canadian Northwest mounted police have been obliged to abandon the lonely outpost which the Dominion government maintains, at a cost of over $100,000 a year, on Herschel Island, in the Arctic Ocean, for the purpose of collecting duties from American whalers and prospectors, keeping order among the Eskimos, and assuring Canadian sovereignty in the far North. This action is due to the fact that the steamer bringing supplies from Nome was unable to reach the post on account of storms and ice floes, and may add to the perils of several vessels, including part of Stefánsson's expedition, supposed to be icebound in that vicinity.

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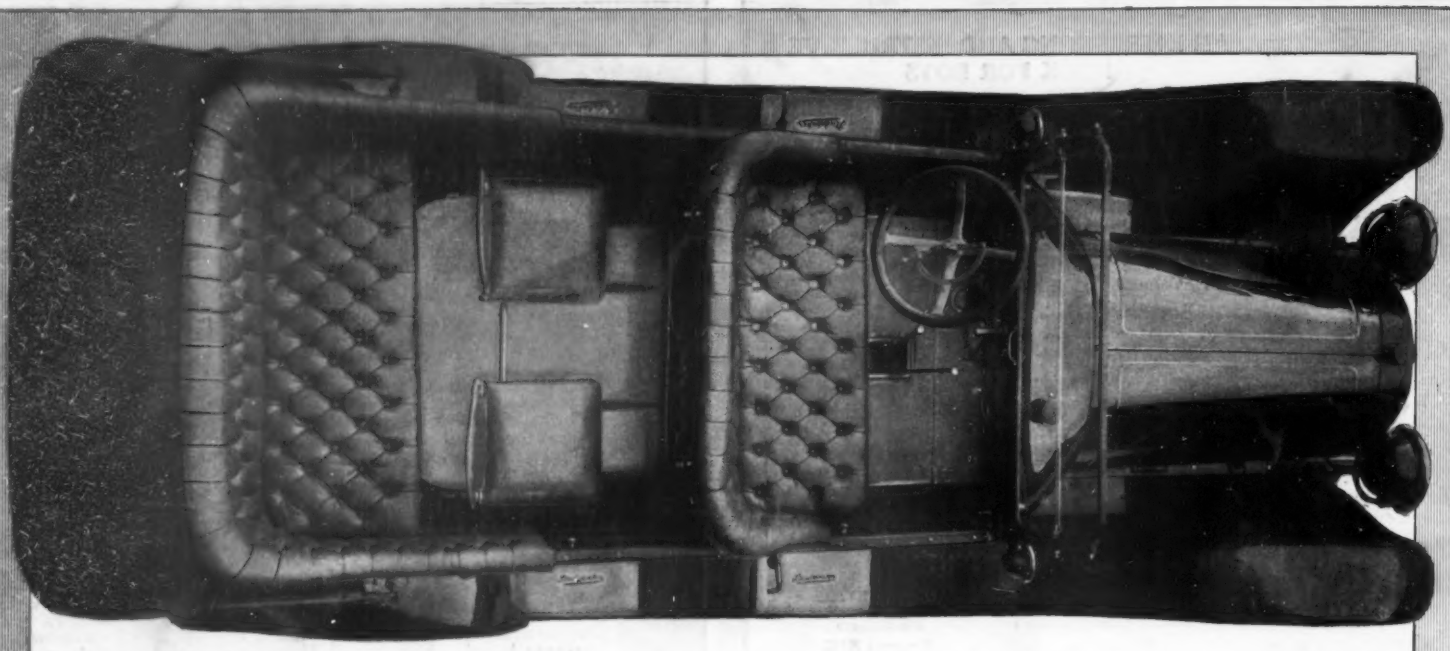

This is a faithful photographic reproduction of the Studebaker SIX taken from above and showing the complete and generous proportions of the car and its seating arrangements for seven passengers.

Seven Passenger
Electrically Started
Electrically Lighted
Full floating rear axle

F. O. B. Detroit

FOUR Touring Car	$1050
SIX Touring Car	$1575
SIX Landau-Roadster	$1800
SIX Sedan	$2250
"25" Roadster	$875
"25" Touring Car	$885
"35" Touring Car	$1290
"35" Coupe	$1850
Six-Passenger SIX	$1550

F. O. B. Walkerville, Canada

FOUR Touring Car	$1375
SIX Touring Car	$1975
SIX Landau-Roadster	$2350
SIX Sedan	$2950

Canadian Factories
Walkerville, Ontario

STUDY for a moment the striking picture which shows the roominess of the seating arrangement in the Studebaker SIX.

Then consider the price—and then ask yourself where in all the world will you find a value to equal it!

Studebaker
Detroit

Studebaker SIX $1575

Buy It Because It's A Studebaker